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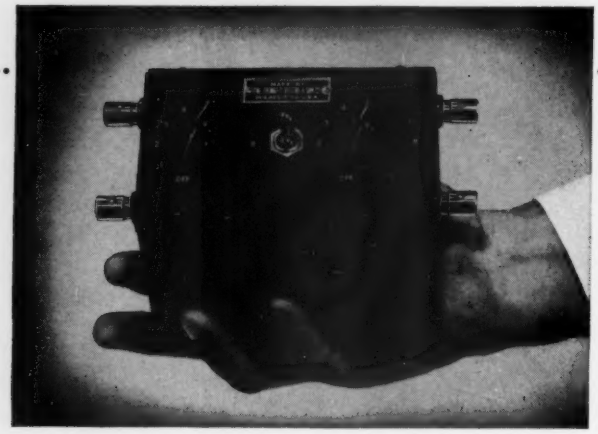

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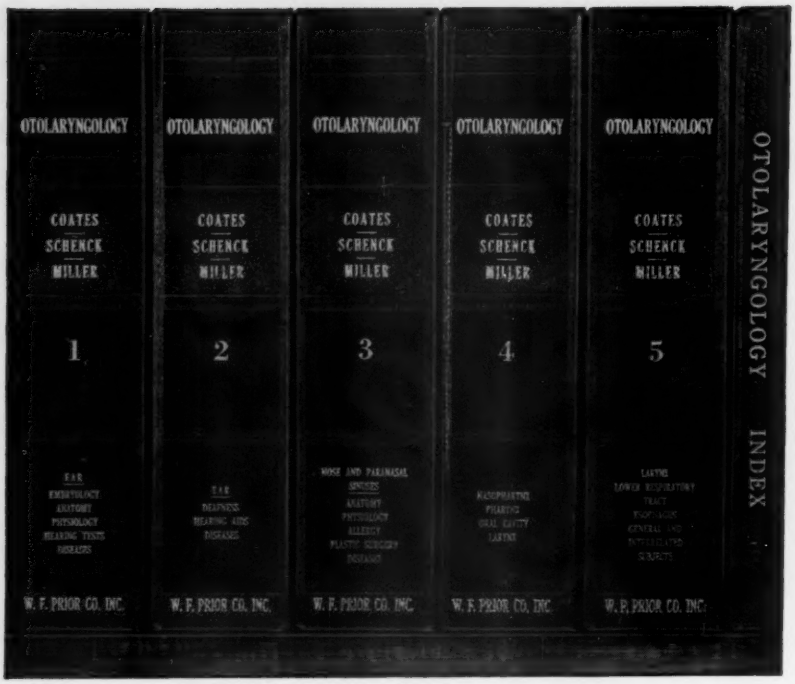

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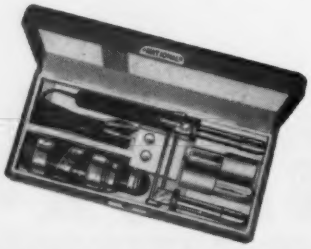

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Acoustic Trauma

MAURICE SALTZMAN, M.D.
and
MATTHEW S. ERSNER, M.D., Philadelphia

Acoustic trauma may be defined as the sound-induced injury to the neural mechanism of hearing. Most frequently, it represents the effects of chronic auditory fatigue, the onset being insidious and loss of hearing slowly progressive, while tinnitus—in the uncomplicated case—is either entirely absent, or it is mild and not readily measurable. Larsen [1] observed that frequently after the initial exposure a person experienced a ringing or buzzing in the ear and that the tinnitus vanished after staying several days in noisy surroundings. Clinically, this type of acoustic trauma is observed in industrial workers who have been exposed to excessive noise for several years. It appears to be in keeping with the natural history of wear and tear. If the intensity of the noise is high enough and a person is exposed to it long enough, some deleterious effect on the organ of Corti must result. The degree of damage, however, depends upon the individual resistance or tolerance. In Barr's [2] study, there was not one boilermaker in a hundred who had normal hearing after working at his trade for more than four years. Among certain metal working occupations, Temkin [3] found that a whisper could not be heard at 4 m. by any of the men who worked at their trades for 15 years. As each industry is associated with a different type of noise, such as grinding, chipping, hammer blows, the hearing loss will show differences in accordance with the noise characteristics of each trade. The dependent relationship of the hearing impairment to the length of exposure and the intensity level of the industrial noise was demonstrated graphically by Rosenblith.[4] He made a survey of the average hearing loss of three groups of workers, namely, machinists, blacksmiths, and boilermakers.

On the audiogram, the commonest finding is a "dip" around 4000 cps. As the deterioration progresses, the defect broadens out to the right and to the left. A susceptible person working in a noisy occupation for several years frequently shows a profound impairment for the speech frequencies and a low social adequacy index.

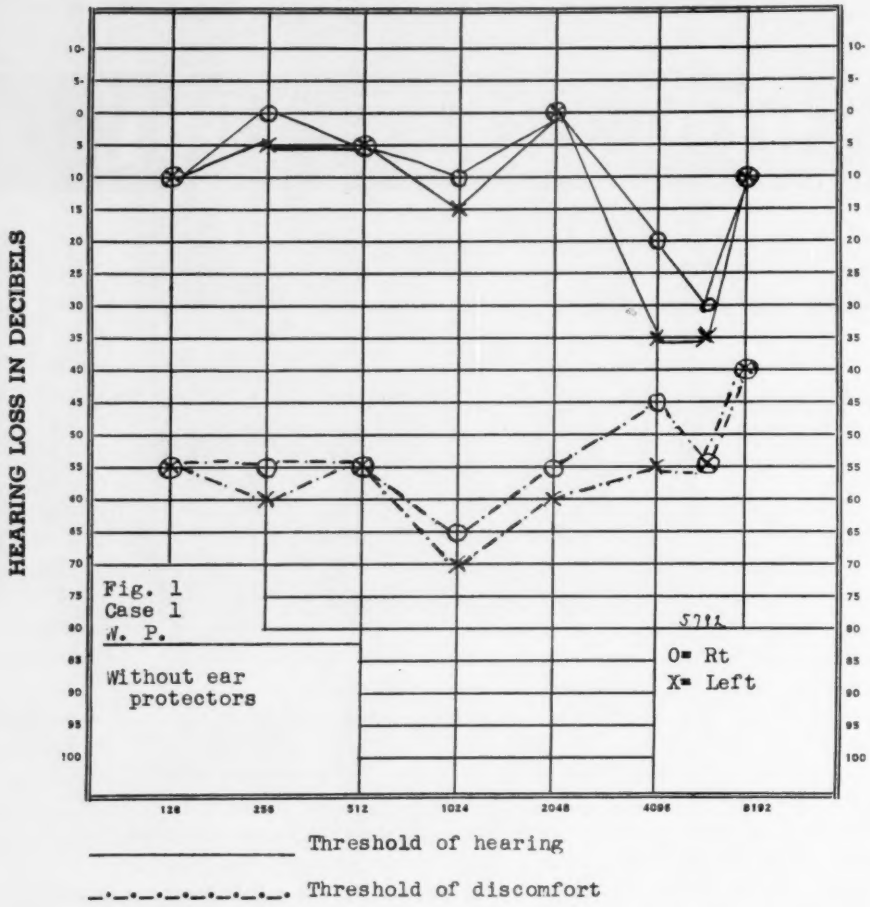
We have encountered several cases of acoustic trauma with noteworthy features. Collectively, these findings make up a unique symptom complex, which suggests a circumscribed lesion in the organ of Corti. A new therapeutic approach has also been evolved. Illustrative cases will be presented.

Submitted for publication Jan. 10, 1955.

From the Hearing Clinic, Department of Oto-Rhinology, Temple University School of Medicine.

REPORT OF CASES

CASE 1.—W. P., white man, aged 29, consulted us on Sept. 18, 1954. His chief complaint was tinnitus in both ears. It began in 1943, after exposure to the detonation of rifles. An aggravation of the tinnitus occurred each time the patient rode in the subway train. In addition to the constant high-pitched sound, he experienced an annoying vibration in the right ear. An intensification of the tinnitus took place after an airplane trip to California. It was due, according to the patient, to the noise of the engines; he felt "no blockage of the tubes."

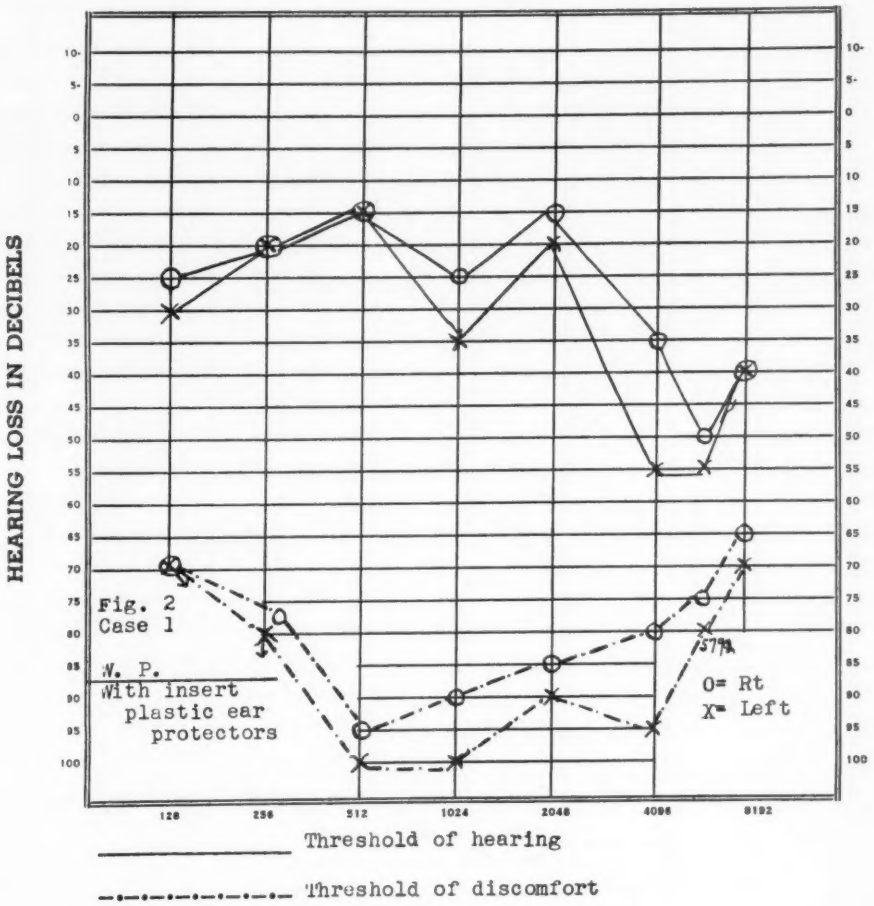


Otoscopy and direct nasopharyngoscopy disclosed no abnormality. Both Eustachian tubes proved to be patent by catheterization and politzerization. There were no abnormal neuro-otologic findings, and the caloric test yielded normal responses from both ears. Audiometry disclosed diplacusis for tones 2048 to 8192 cps, the pitch being higher in the right ear. There was a pronounced lowering of the threshold of discomfort, which was more marked in the right ear. The measurement of the tinnitus was rather precise. It compared closely with frequency 7592 cps at an intensity of 35 db., bilaterally. On the presentation of this sound, beats were experienced. At an intensity of 40 db., this frequency blended with the tinnitus, and at 50 db. it became intolerable. Figure 1 is the patient's audiogram, which presents also his threshold of discomfort.

There was no psychogenic element in this case. The disturbance in the ears initiated by a loud sound was similar to the irritation to an injured larynx caused by smoke. Accordingly, the patient was provided with insert plastic ear protectors. His relief was dramatic. Now he can ride in a subway train without initiating a vibratory sensation in his right ear. There was a noteworthy elevation of the threshold of discomfort, while speech hearing was not severely affected. Figure 2 affords a graphic illustration of these facts.

The ear protectors brought about some amelioration from the high-pitched tinnitus, but the 7592 cps tone, in a subdued form, continued rather constantly. Temporary masking could be obtained by high-frequency sounds at intensities close to the threshold of hearing.

CASE 2.—G. F., white man, aged 29, came to us on Oct. 13, 1953, with the complaint of high-pitched tinnitus in the left ear. Noise was most annoying to the ear, and the tinnitus was intensified on exposure to high-frequency sounds coming from a whistle, bell, or violin. Otoscopy and direct nasopharngoscopy disclosed no abnormality. The Eustachian tubes were patent. There was no abnormal neuro-otologic finding, and the caloric test



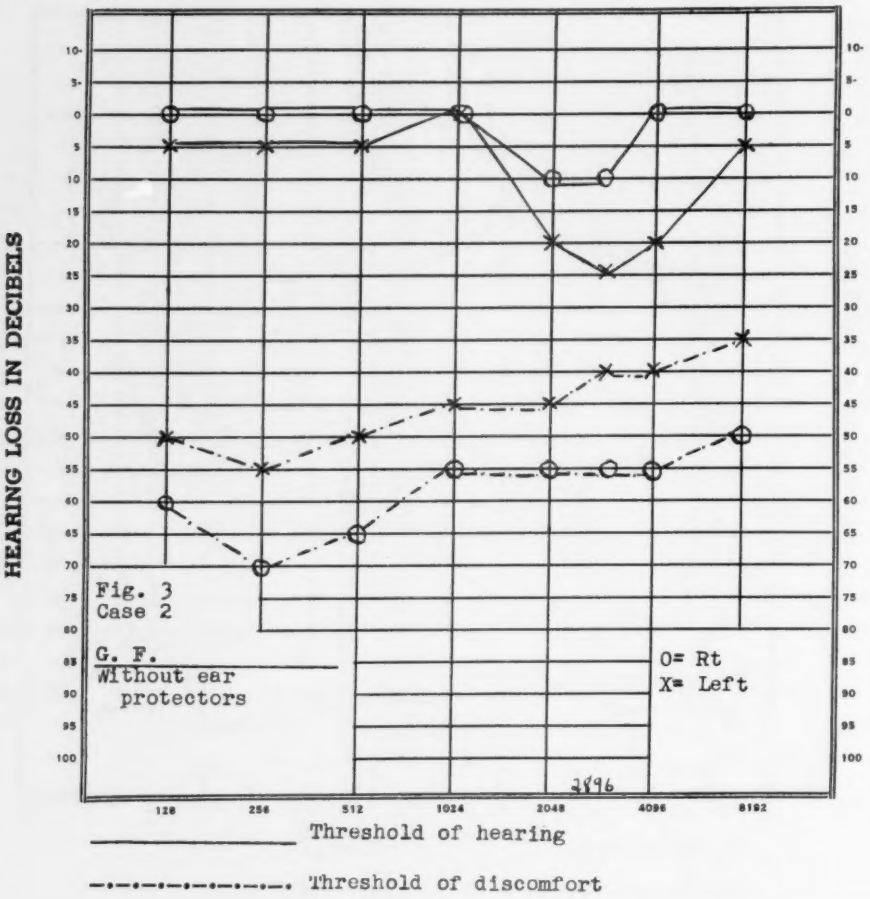
yielded normal responses. Because the tinnitus began in 1941, while the patient was in a battle zone, it appeared that it had its incipiency after the detonation of a cannon. Audiometry disclosed a high-frequency wedge, with the apex at the 2896 cps tone. The measurement of the tinnitus was precise. It compared with the 2896 cps at an intensity of 30 db. The threshold of discomfort was markedly lowered, being most pronounced in the high-frequency zone. There was diplacusis for all tones above 2048 cps, the pitch being higher in the left ear. Figure 3 presents both the threshold of hearing and the threshold of discomfort.

Insert plastic ear protectors proved of considerable therapeutic value. As shown in Figure 4, there was a marked elevation of the threshold of discomfort, while speech hearing was not severely affected. The patient reported that he obtained a soothing effect from listening to low-tone musical instruments. In the laboratory, the tinnitus appeared to be subdued or masked by a 128 cps tone at an intensity of 30 db. or white noise at an intensity of 30 db.

COMMENT

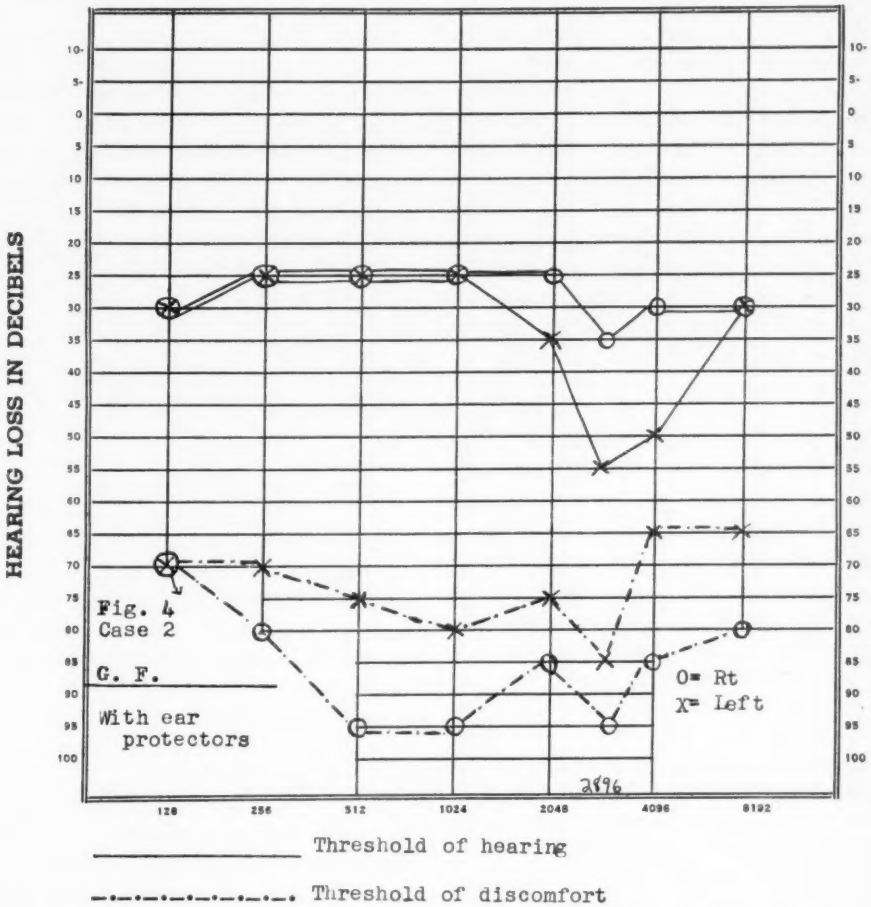
The presence of a localized lesion in the organ of Corti is suggested by a wedge-like defect in the audiogram and tinnitus aurium which compares precisely in frequency and intensity with the apex of the notch. Diplacusis is frequently found in cochlear deafness. We * observed the existence of a lower threshold of discomfort in some cases of inner-ear pathology. What is unusual about the clinical reports presented here is the extremely low threshold of discomfort, which is most pronounced for the high tones, and the fact that an irritating sound intensifies the tinnitus to such a marked degree. It

* References 5 and 6.



would appear that the organ of Corti might harbor an actual wound which is localized and which is subject to disturbance by the ingress of a specific sound pressure. That a localized wound in the cochlea can be produced by a sound has been proved experimentally by Guild,[7] who exposed guinea pigs to the sound of revolver shots at close range. At postmortem, the commonest finding was the loss of a single or a few adjacent hair cells—usually associated with a displacement of the corresponding Deiters' cells. Thompson[8] hypothesizes that sound vibrations of great condensation become shock waves. The devastating effect has its greatest impact on the most exposed and susceptible part of the cochlea, the area around the 4000 cycle. It is probable that recovery is impeded by the subsequent exposure to irritating sounds which add insult to injury. The therapeutic value of ear protectors is obvious. Case 2 found listening to white noise at an intensity of 30 db. "most soothing" to his tinnitus. It is probable that a systematic exposure to specific sounds for lengthy periods may constitute a worth-while physiotherapeutic measure in certain types of tinnitus. We have utilized this procedure in some cases to good advantage. There is a twofold effect—masking and the increase of the patient's tolerance to "sound in the ear."

Occasionally, acoustic trauma leads to a sequel which has implications of diagnostic and medicolegal importance. As pointed out by Watkyn-Thomas,[9] there is a possibility



of a slow progressive degeneration after a sound injury to the cochlea; a condition resembling premature senile deafness may eventuate in the course of time. A man may trace back his progressive nerve deafness to a week's employment in a mine several years previously when he was exposed to the detonation of an explosive. The variations in the residual hearing loss of employees of noisy occupations who are of similar age and length of service and with no middle-ear disease might be due, partly, to differences in tendency to degenerative changes, in addition to individual susceptibility to sound injury. An analogous sequel is occasionally observed in craniocerebral trauma. The initial hearing loss is augmented, as time goes on, by the process of secondary degeneration.

Experimentally, Perlman † induced a marked hearing loss by the presentation of the 2048 cps at an intensity of 100 db. for one hour, while no threshold change occurred from the exposure to 64 cps at a similar intensity and duration. Davis and associates [11] found that the presentation of a masking sound to the ear for a brief period causes a loss of sensitivity at a frequency one-half octave above the exposure tone, sometimes extending to one or two octaves above. With a prolonged exposure, the hearing loss tends to spread more and more to the high-tone range, regardless of the frequency of the exposure tone. Airplane noise, of the old open-pit models, with most components in

† Perlman, H. B., in discussion on Lurie, Davis, and Hawkins.[10]

the 100 to 300 cps range affected the 4096 cps tone first, even after a brief exposure, according to Campbell and Hargreaves.[12] It could have been due to the fact that certain engines might have outbursts of excessive sound pressure or the noise would include sudden instantaneous peaks of high frequency. The noise of modern jet engines causes no appreciable hearing loss after a brief exposure, as reported by Sataloff.[13] This noise must be free of sudden peaks, and its mixed frequency components may be conducive to adaptation easily.

In the experiments on auditory fatigue, the length of time required for recovery seemed to depend upon the duration, intensity, and frequency of the exposure tone. Wilson[14] is of the opinion that the ear which is most easily fatigued on exposure to a loud sound is more susceptible to acoustic trauma. In his experiment, a rise in threshold of 10 db. or more one minute after a five to eight minute exposure to 256 cps at an intensity of 80 db. was considered a positive fatigue test. In a group of 85 soldiers who were studied by Wilson, those with a positive fatigue test showed a greater incidence of untoward ear symptoms following their course of firing at the rifle range.

Testing for the threshold of discomfort will pick out the sound-injured ears and those with early nerve degeneration. These ears usually have a low tolerance for loud sounds and are most susceptible to further deterioration.

By the hypothesis of Cantor,[15] sound waves of high intensity may gain entrance into the middle ear through the pathway of the Eustachian tube. Blast frequently ruptures the membrana tympani at its anterior-inferior quadrant. The shock waves coming by way of the Eustachian tube break through the drum membrane toward the external acoustic meatus. In one of Cantor's cases, the drum membrane ruptured only on the side with a patent Eustachian tube, while on the side with a closed tube, no injury occurred. The act of swallowing, which opens the pharyngeal orifice of the tube, would favor the ingress of shock waves into the middle ear.

Actual contact is required for the bones of the skull to become a medium of transmission for sound vibrations of lesser magnitude. However, when the shock wave level is reached, the devastating vibrations surge forward most readily into open channels. In situations where shock waves may develop, such as explosions or industry with noise characterized by outbursts of excessive sound pressure, the exposed person who keeps on chewing and swallowing is faced with a greater hazard. He keeps his Eustachian tube open for a shock wave, that may develop, to ingress into his middle ear readily.

SUMMARY

There are three different types of acoustic trauma: 1. The insidious and slowly progressive. As the result of exposure to excessive noise over a period of years, most people show a variable degree of deterioration of hearing. Prophylactic measures include the making of working conditions more quiet by engineering inventions and the personal hearing conservation program of the worker by wearing insert ear protectors or over-the-ear devices.

2. The sound-injured inner ear. This type frequently follows a brief exposure to the detonation of a cannon or rifle, and it presents the symptom complex of a wedge-like high-frequency loss, tinnitus which is precisely measurable, diplacusis, and a marked lowering of the threshold of discomfort. Remedial indications include absolute quiet working conditions, raising the threshold of discomfort by wearing insert ear protectors, and, in some cases, exposures to specific masking tones as a physiotherapeutic measure.

3. Progressive degeneration after sound injury. Even without further exposure to noise since the initial havoc, the deterioration of hearing continues, leading to premature presbycusis. This type, which is occasionally encountered, is to be guarded against infections, cochlea-toxic drugs, avitaminosis, and exposure to noise.

1923 Spruce St.
1915 Spruce St.

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Papilloma of the Larynx in Children

HEINRICH W. KOHLMOOS, M.D., Oakland, Calif.

Papillomas are among the commonest tumors found in man. Characteristically the masses grow from surface epithelium, but they may originate in epithelium lining glandular ducts. Malignant changes may take place with deep infiltration into surrounding structures, but the tumors are basically benign in nature. In specific instances the new growths are so extensive, recur with such rapidity, and are so detrimental to the person's general health that they might be classified as morphologically benign but from all practical aspects locally malignant. Papilloma of the larynx in children falls into this latter category.

It is the purpose of this thesis to review the subject of papilloma of the larynx in children as to historical background, etiology, development of various methods of treatment, and careful study of a limited number of cases. With this information it is hoped to determine the optimum treatment for this distressing disorder.

HISTORY

Laryngeal tumors in children are described in early ear, nose, and throat texts. Gibbs [1] in his 1864 edition noted 12 specimens of children's larynxes in London museums. Most, by description, were involved with papillomas, and from the histories available were from children known to have been hoarse since early infancy. Morrell MacKenzie [2] reported a survey of laryngeal tumors in 1880. Of 100 tumors found between 1862 and 1870, sixty-seven were papillomas but only 2 of these were in children. In reviewing the history of laryngeal neoplasms, he noted that Koderik had reported the removal of a laryngeal polypus through the mouth in 1750, while Regnoli in 1836 removed a papillomatous growth after doing a tracheotomy first. Many more cases were reported after the invention of the laryngoscope. MacKenzie was conscious of the severity of laryngeal papillomas in children and discussed the likelihood of obstruction in the small larynx. He made special note of the gravity of papilloma of the larynx in children when complicated by diphtheria. He also noted that the lesions in children were usually multiple and tended to recur while in adults solitary lesions were commoner.

Bosworth,[3] in 1892, listed 12 well-authenticated case reports of papilloma of the larynx in children. He described in detail the frequent recurrences and believed them to be due to inadequate removal.

Crowe,[4] in his study of laryngeal papilloma in children, reviewed Virchow's work of 1863 in which Virchow stated that laryngeal papilloma is of connective-tissue origin and should therefore be classified as a fibroma, using the papillary characteristics only as a descriptive adjective. Crowe noted that laryngeal lesions in children are true papillomas of connective-tissue origin rather than papillary hypertrophy of epithelial origin. The latter, often due to long-standing irritation, is the type of tumor seen in adults. He emphasized this morphological difference in the tumors in adults and children and also stated that the lesions in children recurred frequently and were easily transplanted to other areas. Neither of these characteristics is noted in adult laryngeal papillomas.

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From the Division of Otolaryngology, Department of Surgery, Stanford University School of Medicine.

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ETIOLOGY

The early writers, as today's authorities, did not agree as to the etiology of laryngeal papilloma in children. MacKenzie [2] thought them to be congenital or due to chronic congestion following an acute inflammation. St. Clair Thomson [5] regarded them as an inflammatory reaction probably due to a filterable virus and closely related to warts on the skin.

Clark [6] in 1905 described the lesions in children as mildly contagious and easily implanted on other laryngeal structures following surgical manipulation.

In 1923 Ullman's [7] oft-referred-to work was reported. Using material from the laryngeal papilloma of a 6-year-old boy, he reported positive innoculatory results on the human arm, palate of the dog, and vagina of the dog. Two of the six attempts at transmission with bacteria-free filtrates were positive. Ullman concluded that laryngeal papillomas in children are due to a filterable virus. He was unable to get positive innoculatory results with material from three adult papillomas.

Findley is reported by DeMonbreun [8] to have been unable to confirm Ullman's claims. DeMonbreun himself easily transmitted the oral papillomas of dogs in series, and Shope [9] repeatedly proved the transmissibility of Berkefeld filtrates of rabbit papillomas. Rabbits so infected developed transient immunity. Frugoni [10] concluded that laryngeal papillomas in children were not viral in origin when he failed to produce antigens in animals injected with filtered emulsions of papillomas.

There is no record of other confirmation of Ullman's studies, although the infectious nature of the disorder is often mentioned. Reported response to antibiotics by Holinger,[11] Bradburn,[12] Green,[13] and others are points in favor of this theory.

Promising results with the use of estrogenic hormones by Broyles * and later by Zalin [17] stimulated interest in the endocrine factors as etiology of laryngeal papilloma, but conclusive evidence has not been presented. The self-limited nature of the disorder and the usual clearance by puberty are points stressed by those feeling endocrine influences are important.

Conclusion as to true etiology of these masses is not definite. The various factors mentioned as playing a role are listed as congenital, hereditary, constitutional, endocrine, inflammatory, viral, and chronic congestion. The papilloma in children must still be classified as a true neoplasm rather than the result of these factors.

INCIDENCE

Papilloma of the larynx is not uncommon. There are few large series of cases reported. Jackson [18] reported good results in 200 cases. Holinger † reported 109 papillomas of the larynx, 54 of which were in children 16 years of age or under. He [20] later reported six additional cases, four of which were in children. New ‡ reported on 722 benign laryngeal tumors at Mayo Clinic in 30 years; 194 were papillomas, and 40% of these were in persons under 20 years of age. Spelman,[23] reporting on unpublished findings of Farber, noted that, between 1916 and 1947, of 15,293 consecutive surgical specimens at Children's Hospital in Boston 92 were laryngeal papilloma—a ratio of 1 in 160 specimens. Zalin [17] reported that 1 case per 6000 entries at this hospital was laryngeal papilloma, while at Massachusetts General Hospital the ratio was 1 : 1000. Crowe [4] in his review noted that Rosenberg in 1896 reported 16 cases in 5808 children under 13 years of age and Schrotter in 1892 reported 10 in 7324 children under 10 years of age. There are many discussions and case reports on laryngeal papilloma in children.§ In most reports, the incidence is highest in the 1- to 4-year age group, with incidence approximately equal in males and females. There is no evidence of unusual race or geographical distribution.

* References 14 to 16.

† References 11 and 19.

‡References 21 and 22.

§ References 24 to 34.

PATHOLOGY

Laryngeal papillomas in children are true papillomas with irregular folds of well-differentiated stratified squamous epithelium, a framework of vascular connective-tissue stroma, and a good basement membrane. Grossly, the tumors are cauliflower-like or pedunculated nodular masses varying in color from gray to red. There is great variation in degree of pedunculation of the lesions, and there is evidence that the sessile lesions tend to recur and spread more readily in children than do the pedunculated papillomas in the same age groups. In the limited number studied in the present series, there was a distinct variation in severity of cases according to gross morphological picture. The pedunculated lesions grew slowly and rarely extended from the vocal cords, while sessile lesions in children of the same age were extensive, recurred rapidly, and were transplanted to the trachea and bronchi, causing serious sequelae. Sessile papillomas are difficult to remove without damaging normal underlying laryngeal structures, and they therefore may not be as completely extirpated at surgery as are pedunculated papillomas.

CLINICAL PICTURE

The cases reviewed in this study follow closely the pattern described by other authors in much larger series. There is great variation in the course of individual cases, but the pattern is similar.

Hoarseness is the symptom common to all. It may be noted when the child first attempts to talk, or parents may note a hoarse type of cry even before the age of one year. The degree of hoarseness varies with the size and spread of the tumors. Respiratory obstruction, with wheeze, noisy breathing, sternal retraction, and, finally, acute respiratory distress, develops as the glottis fills with tumor. Tracheotomy is often necessary for this obstruction, and it may be needed for several years. In one of the cases under observation, tracheotomy has been in for six years consecutively. In a second case the tracheal cannula was reportedly reinserted on three distinct instances over a period of seven years. In several of the cases in this series, as well as numerous reports in the literature, lower respiratory obstruction has developed from tracheal implants, necessitating repeated bronchoscopy through the tracheal stoma.

In mild cases removal of tumor once yearly for two to three years has been sufficient, while in others more than 100 procedures have been necessary. Spontaneous recovery with complete disappearance of tumor masses before the age of puberty is almost universal. The time of such remission is unpredictable, and the cause has not been determined.

DIAGNOSIS

Diagnosis of laryngeal papilloma is proved by laryngoscopy and biopsy. Rarely is indirect biopsy possible in children. Direct vision is obtained under general anesthesia, either with the Jackson type of laryngoscope or by suspension laryngoscopy. The general anesthesia may be a very dangerous procedure, and in persons with signs of respiratory obstruction tracheotomy may be necessary before adequate laryngoscopy for diagnosis can be made.

The gross picture is that of a cauliflower-like or pedunculated lesion of the vocal cords with extension to any part of the larynx, including false cords, aryepiglottic folds, and epiglottis, in some cases spilling over into the pyriform fossae. In several cases in the series studied, tumor completely obliterated normal glottic architecture, entirely obstructing the glottic chink. Extension subglottically is exposed with an anterior commissure type of laryngoscope or bronchoscope. In tracheotomized patients the bronchoscope may be passed through the tracheotomy stoma for exposure of implants in the trachea or bronchi.

DIFFERENTIAL DIAGNOSIS

Papilloma of the larynx is easily diagnosed after biopsy, but prior to such procedure the various disorders of children causing hoarseness and respiratory obstruction must be considered in the differential diagnosis. Developmental anomalies, including laryn-

gomalacia, infantile epiglottis, congenital web, cartilaginous deformities, and congenital cysts of the larynx or tongue, must be considered. Holinger [19] includes vocal cord pareses due to congenital cardiac disease, birth injuries, vascular anomalies, and central lesions as causes of hoarseness in infants. Acute infections (including diphtheria and nonspecific laryngitis), chronic infections, syphilis, acid-fast infection, and neck trauma with resultant laryngeal damage are included in differential diagnosis. O'Keefe [35] mentions foreign body of the larynx in his listing of causes of obstruction. Papilloma must be differentiated from other laryngeal new growths. Vocal nodules, or "screamer's nodules," are the commonest, but vocal cord polyps and cysts are included. Malignant tumors of the larynx are rare in children, and will be ruled out by biopsy.

TREATMENT

Treatment of papilloma of the larynx in children has not been and is not as yet universally successful. A great variety of treatments has been prescribed and reported, with success only fleeting and recurrences common.

As long ago as 1905, Clark,[6] after attempts to cure cases by multiple surgical procedures, concluded that tracheotomy for obstruction and no further interference was the treatment of choice. He stated, "Growths will not yield to any form of treatment which has been attempted, however radical, until the period of active growth has passed."

Morrell MacKenzie [2] outlined the treatment in his text in 1880, and these treatments were followed by others for years Attempts were made to remove the tumors by endolaryngeal approach under chloroform anesthesia. After removal of the tumor, the area was cauterized with caustics, such as silver nitrate or nitric acid, or by galvanic cautery. If tumor recurred, MacKenzie advised the extralaryngeal approach in the form of the laryngofissure. This latter procedure was soon condemned because of permanent laryngeal damage and the high incidence of recurrence in spite of complete clearance of gross tumor at surgery.

Long courses of arsenicals, potassium iodide, calcined magnesia, and many other drugs were advocated,[36] but no persistent cures were reported. Broyles ‖ in 1941 reported optimistic results with the use of estrogenic hormones applied locally to the larynx. Zalin [17] and Lumsden [28] reported similar gains in a limited number of cases with other female hormones applied locally.

Hollingsworth [37] in 1950 reported on the local application of podophyllum resin, with lessening of tumor growth and increased ease of removal. Holinger [19] noted unfavorable results in two cases in which he used podophyllum.

Foster ¶ and others, including Solomon,[41] advocated radiation therapy in the form of external radiation or radium application. Initial studies were promising, but long follow-up was not reported. The use of laryngeal radiation in children has been condemned by Clerf [42] as dangerous and causing severe scarring and poor development of the larynx, with resulting stenosis. Lumsden [28] and Salinger [43] also report severe sequelae following radiation of the larynx in children. Cartilage destruction, poor development, stenosis, and persistent growth of the papillomas were noted. Broyles [16] also condemned the radiation therapy.

Many authors advocate only careful removal of the laryngeal tumors at intervals either by suspension laryngoscopy or by using a Jackson type of laryngoscope. LeJeune [44] favors the former. The importance of guarding against damage to normal laryngeal structures is stressed. Tracheotomy is necessary as soon as obstructive signs are noted and must be maintained for years if necessary.

Hubbard [45] in 1925 advocated fulguration. New [21] advocates touching lightly each of the tumor masses with weak cautery at the time of removal. Jackson [18] feels that any form of cautery will cause deep structure damage.

The use of antibiotics has been advocated and, in some cases, has shown favorable

‖ References 14 to 16.

¶ References 38 to 40.

results. Their use has not been wholly successful but may be an adjunct to surgical removal. Holinger [11] reported encouraging results with the use of chlortetracycline (Aureomycin) in seven children with laryngeal papilloma. Bradburn [12] used oxytetracycline (Terramycin) in similar cases, with excellent results in two of four cases and improvements in the remaining two. Green [13] reported one case with favorable follow-up following the use of chlortetracycline, but there have been no other larger series reported with good results.

The consensus of many authorities is that optimum treatment is careful removal of the tumor masses to insure adequate airway and performing tracheotomy, if necessary, the latter giving the larynx rest and possibly slowing the tumor growth. The care in removal of the masses without damaging underlying structure is stressed repeatedly. The disorder is self-limited and will clear with age; therefore, operative procedures should not be so radical as to injure normal laryngeal structures.

COMPLICATIONS

Complications of laryngeal papilloma in children can be separated into two groups: first, those complications of the disease entity itself and, secondly, complications of the treatment.

(*a*) Hoarseness is a symptom of papilloma. If carefully treated, the voice should be normal as the disorder regresses. Children with extensive tumor growth during activity of the disease have developed normal voices with remissions. If treatment is too vigorous and underlying structures are damaged by surgery, cautery, or caustics, the complication of abnormal voice persists.

(*b*) Laryngeal obstruction, with all its ramifications of dyspnea and finally asphyxia, is the serious complication of untreated papilloma. In spite of tracheotomy, lower respiratory obstruction from tracheal or bronchial implants is not uncommon, and in several cases discussed here repeated bronchoscopies through the tracheal stoma were necessary to insure aeration by removal of these implants.

(*c*) Implants in the trachea and bronchi may be spontaneous or the result of overzealous manipulation. Intubation or bronchoscopy should be done only if there is definite indication of extension of the tumor and need for removal, as tracheal implants may be due to this surgical trauma. Such cases are reported by Kirchner [46] and Patterson.[47] Hitz [48] reported aerial metastases in which papillomas were found in small cavities in the lung on postmortem examination of a 4-year-old boy with papilloma of the larynx. No implants were noted in the trachea or large bronchi.

(*d*) Laryngeal stenosis and cartilage damage following radiation therapy has been reported. The same was noted when laryngofissure was common therapy. Neither of the methods is now advised, and so this complication has been minimized.

(*e*) Aspiration pneumonia due to spillage of food and oral secretions following surgical damage to laryngeal structures is possible. Arytenoid damage was noted in one case studied here, and tracheal esophageal fistulae have been mentioned. Atelectasis and pneumonia with lower respiratory implants is a further complication.

(*f*) Web formation at the anterior commissure following repeated removal of papilloma is not uncommon. This was the complication of three patients in the series and in two cases was treated successfully by the method described by McNaught.[49]

(*g*) Carcinoma of the larynx following papilloma of the larynx in children is a rare complication. Walsh [50] reported two such cases, and LeJeune [51] reported his famous case of Warren Bell. In adults the transition is commoner. Mitchell [33] reported four adult patients with benign papillomas which became malignant. Clerf [52] reported that of 250 cases of cancer of the larynx 3 had previously had benign papillomas. Boies [53] reported a case of known papilloma recurring from the age of 5 to 40 years with no evidence of malignant change.

(*h*) Tracheal fistulae following long tracheotomies for obstruction from papilloma are a common complication. Good closure can readily be obtained by adequate plastic procedures.

PROGNOSIS

If adequate facilities for treatment are available and accepted, prognosis is good. The disorder has such a long duration that parents must be extremely cooperative to cope with this distressing picture. Tracheotomy care and protection of the child for years without making a complete invalid of him is a difficult problem taxing the ingenuity and patience of the parent undertaking nursing care. Overzealous surgical treatment is to be condemned. Tracheotomy must be considered early for good prognosis. If preliminary reports with antibiotic therapy are an indication, prognosis will be improved in the future, but as yet there is no proof to make these predictions definite.

Jackson [18] states that although these lesions reappear repeatedly they will eventually clear and the child will have a perfect voice and normal larynx, provided there was no operative injury to normal tissues. The average duration of treatment of his 200 cases was two years.

REPORT OF CASES

The following 15 cases of papilloma of the larynx in children have been studied during the past eight years. Each case presented distressing problems of its own, not only for immediate treatment of the tumor but distinct problems in treatment of the child as a whole from a physical as well as a psychological standpoint. This can be readily understood when parents must be told that their child may need the closest observation for 9 to 10 years with almost constant guarding against respiratory obstruction. Measures must be undertaken to prevent those children from becoming complete invalids.

Cases will be discussed briefly with only salient points presented in each instance to illustrate given characteristics. Papilloma was proved by biopsy in all cases. With one exception all laryngoscopies and bronchoscopies were performed under general anesthesia.

CASE 1.—T. W., a 3½-year-old boy, first seen in November, 1947. History of hoarse cry since birth and increasing hoarseness with first speech. Laryngoscopy at age of 15 months was reported as proving diagnosis of laryngeal papilloma. The same procedure was repeated at six-month intervals. A proprietary estrogen preparation (Amniotin) in oil spray had been used regularly for six months prior to our initial examination. Laryngoscopy under general anesthesia in November, 1947, revealed a large subglottic papillomatous mass at the anterior commissure, with no gross tumor on the remainder of the larynx, although the cords were slightly thickened. The mass was removed with cupped forceps. Direct laryngoscopy was repeated in February, 1948; May, 1948, and April, 1952. In each instance small papillomas were removed from the anterior commissure. No other treatment was undertaken. Indirect examination in August, 1954, revealed normal vocal cords with no evidence of tumor or commissure thickening, and the voice was excellent.

CASE 2.—G. W., a boy, first seen at the age of 5 years, in 1951, with a history of hoarseness for six months. Direct laryngoscopy revealed papillomatous masses at the anterior third of the right cord. These were removed with cupped forceps, and microscopic diagnosis was papilloma. In spite of insistence that the parents return with the child at frequent intervals for examination, he has only been returned when the voice was completely lost and noisy respirations developed. This has followed the peculiar pattern of once each year for the past three years, and in each instance a large pedunculated papilloma was removed from the anterior third of the right vocal cord. The mass removed in May, 1954, almost completely obstructed the glottic chink when the larynx was relaxed under general anesthesia.

CASE 3.—R. M., a boy, first seen at the age of 6 years in 1949. History of hoarseness since age of 1 year and papillomas removed at the age of 18 months and at intervals of approximately one year. Laryngoscopy in February, 1949, revealed thickened vocal cords with rough, irregular surface but no papillomas. In January, 1950, papillomas were removed from the middle third of the right cord and one papillomatous mass, 3 to 4 mm. in size, was removed from the posterior tracheal wall just above the carina. Ten per cent podophyllum resin in 95% alcohol was applied to such areas. Microscopical studies showed the specimens to be papilloma. Repeat endoscopies in March, 1950; January, 1951, and January, 1952, showed no evidence of recurrence, and the child has been symptom-free.

CASE 4.—D. L., a boy, first seen at the age of 2 years in July, 1950, with a history of hoarseness for two months and increasing respiratory distress and noisy respirations for two to three weeks. Laryngoscopy exposed shallow papillomas on the anterior two-thirds of both cords and a large subglottic mass on the right. These were removed with cupped forceps, and the areas were painted with 10% podophyllum in 95% alcohol. Laryngoscopy and podophyllum application were repeated three times during the next 12 months, with smaller masses removed in each instance. Laryngoscopies in January, 1952; May, 1953, and April, 1954, were performed for the removal of small papillomas. Voice has remained excellent the past six months.

CASE 5.—B. S., a 5-year-old girl, first seen in January, 1949, with a history of hoarseness from the age of 2½ years. Papillomas were removed in 12 procedures between the ages of 2½ and 5 years. Laryngoscopy in January, 1949, revealed small papillomas on the anterior two-thirds of each cord. These were removed with cupped forceps, and in five-year follow-up there was no evidence of recurrence.

CASE 6.—E. P., a 21-month-old girl, was first seen, in 1949, because of hoarseness of two months' duration. Two large papillomatous masses on the left cord and false cord were removed, and 10% podophyllum in alcohol was applied. The procedure was repeated eight times at two-week intervals, following which there has been no evidence of recurrence.

CASE 7.—C. C., a 3-year-old girl, was first seen in August, 1951, with a history of persistent whispered speech. Laryngoscopy was performed, exposing diffuse papillomas at the anterior third of both cords. Tumors in this area were removed three times in the next four months, following which there has been no evidence of recurrence of papillomas, but scarring and web formation were noted at the commissure. In March, 1953, the web had reached the middle third of the cords. At this time a McNaught procedure with tantalum plate insertion was performed at Stanford Hospital. The plate was removed in two and one-half months, and follow-up during the next year revealed no evidence of further web formation or papilloma regrowth. The voice is good.

CASE 8.—J. A., a boy, first seen in July, 1951, at the age of 5 years. There was history of hoarseness at the age of 10 months, tracheotomy at the age of 20 months, and 38 laryngoscopies subsequently for removal of papilloma. In July, 1951, small papillomas were removed from the anterior third of the right vocal cord, and on subsequent examinations a web was noted at the anterior commissure. Tracheotomy was closed in March, 1953, at which time there was no evidence of papilloma recurrence. One year later the web was noted to be more extensive, and in July, 1954, excision of web and tantalum plate insertion as described by McNaught was performed at Stanford Hospital. Immediate postoperative course has been uneventful.

CASE 9.—R. K., a boy, first seen at the age of 2½ years in December, 1947, with a history of hoarseness since the age of 15 months. Papillomas had been removed soon thereafter, and tracheotomy had been performed six months before entry. Laryngoscopy in December, 1947, revealed papilloma blocking the entire laryngeal chink and extending into each pyriform fossa. No normal laryngeal structures could be made out. In the ensuing months tumor extended down the trachea and implants in both main stem bronchi were removed. From December, 1947, to August, 1954, laryngoscopy and bronchoscopy were performed at least once each month and, during some periods, bronchoscopy through the tracheal stoma was performed twice weekly to relieve tracheal and bronchial obstruction from the tumor. The laryngeal masses decreased in extent initially with repeated removal and application of podophyllum in alcohol, and a small glottic chink developed. Repeated removal is still necessary. Long courses of antibiotics, including penicillin, streptomycin, chlortetracycline, and oxytetracycline, had no appreciable effect on the growth of tumor, and a two-month course of cortisone did not change the picture. Now, at the age of 10 years with nine years' treatment, there has been little gain in the entire picture, although the voice is intermittently improved.

CASE 10.—H. L., a boy, first seen in February, 1949, at the age of 8½ years with history of hoarseness of one month's duration. Blalock cardiac surgery had been performed two and one-half years previously, but no hoarseness had been noted in postoperation follow-up. Tracheotomy and laryngoscopy were performed in March, 1947. A large subglottic papilloma and multiple sessile papillomas of both cords were removed. He subsequently developed a septicemia, for which large doses of sulfadiazine, penicillin, and chlortetracycline were given. Tumor growth recurred during the period of antibiotic therapy, and subglottic masses were removed. In September, 1951, no further growth was noted and the tracheotomy stoma closed. Subsequent indirect examination has revealed no evidence of recurrence, and the voice has remained good.

CASE 11.—M. S., a 2½-year-old boy, first seen in October, 1948. History of hoarseness at the age of 10 months, with laryngoscopy, tracheotomy, and diagnosis of papilloma made at the age of 18 months. Tumor was removed repeatedly, and a course of Amniotin spray had no apparent effect. There were several bouts of pneumonia, for which

long courses of streptomycin and penicillin were given, with no change in tumor growth. Laryngoscopy in October, 1948, revealed complete laryngeal obstruction by the papillomas, and implants were found in the trachea and the left main bronchus. Bronchoscopy and laryngoscopy were performed at weekly intervals for the next four months. Podophyllum in alcohol was applied at each procedure. Rate of growth lessened markedly, and in six months the larynx was near normal. Small masses were removed at six-month intervals in 1951, 1952, and 1953. The tracheal stoma was closed in June, 1953, and subsequent indirect examination in May, 1954, revealed no evidence of tumor recurrence, although both vocal cords were slightly thickened. Voice is excellent.

CASE 12.—K. H., a 20-month-old girl, first seen in April, 1953, with a history of hoarseness for eight months and papilloma diagnosed by biopsy at the age of 18 months. Diffuse papillomas over both cords were noted on laryngoscopy in April, 1953, and podophyllum in 95% alcohol was applied. Tumor growth continued in spite of laryngoscopy at six- to seven-week intervals. Tracheotomy was performed in April, 1954. No change has been noted since the tracheotomy, although the child is in excellent general condition.

CASE 13.—L. G., a 3-year-old girl, first seen in May, 1953, by which time 22 procedures for removal of papilloma of the larynx had been performed. She had developed a pneumothorax in December, 1952, following difficult anesthesia for laryngoscopy. Tracheotomy was performed in June, 1953. Laryngoscopy and bronchosopy were performed at intervals of five to six weeks during the next 18 months for removal of sessile papilloma of both cords and implants on the tracheal wall. Growth of these implants in the entire circumference of the trachea below the level of the tracheotomy tube resulted in obstruction at this level, necessitating removal of tumor through a bronchoscope at two-week intervals during December, 1954, and January, 1955. Bronchoscopies had not been passed beyond the tracheotomy stoma prior to development of this lower obstruction. Therefore, these implants were not the result of direct trauma of instrumentation. There has been no appreciable change in tumor growth following courses of tetracycline (Achromycin) and chlortetracycline, although these drugs controlled complicating respiratory infections. Each of these agents has been given for two weeks on four separate occasions. Total daily dosage of each drug was 0.5 gm.

CASE 14.—W. P., a 5-year-old girl, first seen in May, 1950, two weeks after laryngoscopy had been performed for removal of laryngeal papilloma and the structures so damaged that swallowing difficulties had resulted. The referring diagnosis was esophageal tracheal fistula. Tracheotomy had been performed prior to entry.

Laryngoscopy in May, 1950, revealed diffuse papilloma of both cords and damage to the left arytenoid with obvious spillage of food into the trachea. This was apparently due to overzealous attempts at removal of tumor. She improved on symptomatic therapy and following two subsequent laryngoscopies for tumor removal has remained free of recurrence, although a small web was noted at the anterior commissure in December, 1953. This web subsequently decreased in size.

CASE 15.—J. D., a 15-year-old boy, first seen in February, 1949. Hoarseness had developed at the age of 6 years, and repeated laryngoscopy for removal of papillomas was performed. Tracheotomy had been performed at the age of 9 and following removal with remissions was repeated three times in the next two years. From March to September, 1949, he was examined directly under local anesthesia and podophyllum resin in alcohol was applied to diffuse laryngeal tumors, with almost complete disappearance of tumor by September. He subsequently moved to another locality and was reported to have died under general anesthesia during attempted laryngoscopy.

These 15 cases can be summarized as follows:

1. Age symptoms of papilloma first noted
   (*a*) Eleven before age of 18 months.
   (*b*) Three from age of 2½ to 5 years.
   (*c*) One at age of 8½ years.
2. Age of apparent cure of papilloma
   (*a*) One free of tumor at age of 3 years.
   (*b*) Three free of tumor at age of 5 years.
   (*c*) One free of tumor at age of 6 years.
   (*d*) Four free of tumor at age of 8 years.
   (*e*) One free of tumor at age of 10 years.
   (*f*) One died at age of 16 years.
   (*g*) Four still under active treatment at ages of 4, 5, 8, and 10 years.
3. Treatments
   (*a*) Nine patients had 6 to 14 endoscopic procedures.
   (*b*) Five patients had 40 to 60 endoscopic procedures.
   (*c*) One patient had over 100 endoscopic procedures.

(*d*) Eight patients were tracheotomized.

(*e*) Two patients had McNaught procedures for removal of a web at the anterior commissure.

(*f*) Three showed no change following protracted periods of topical applications of Amniotin.

(*g*) Six showed no appreciable immediate change following prolonged courses of penicillin, streptomycin, chlortetracycline, and tetracycline.

(*h*) One showed no appreciable change after a long course of cortisone.

(*i*) Twelve were treated with topical application of podophyllum resin at the time of removal of tumor. One of these in which podophyllum was applied frequently at short intervals showed marked improvement. Eight improved during the period of tumor removal and podophyllum application. Three showed no improvement.

4. Complications

(*a*) Four developed tumor implants in the trachea and bronchi.

(*b*) Three developed pneumonitis secondary to obstruction from tumor in the lower respiratory tract.

(*c*) One patient sustained damage to the arytenoid from overzealous surgery.

(*d*) Three developed a web at the anterior commissure. Two of these were repaired surgically.

(*e*) One died under general anesthesia (probable).

5. Gross picture of tumor

In general, the patients with solitary masses of papilloma needed fewer laryngoscopies and at greater intervals than those with sessile multiple lesions. Grouping into these distinct classifications was not clear-cut, but the papillomas noted in seven of the eight tracheotomized patients were sessile, multiple, and diffuse, with rapid recurrence. The nine patients needing fewer procedures had tumors primarily at the anterior commissure, and these tumors were not diffuse in nature.

SUMMARY

The subject of laryngeal papilloma in children is reviewed and 15 case reports are presented. Historical development of treatments is discussed, as are theories of etiology. It is concluded that optimum treatment at present is careful removal of tumor masses from the larynx at intervals to insure adequate airway. Early tracheotomy is desirable with signs of obstruction. Care in removal of tumor to prevent damage to underlying structures is stressed.

Antibiotic and endocrine therapy has been reported as giving promising results, but in a limited number in this series no change in tumor growth was noted following such treatment. There was improvement in the general physical condition of patients in whom antibiotics were used, but in each instance such improvement was due to control of pulmonary infection.

Podophyllum resin applied locally may result in diminished tumor growth. Its frequent use in most children is impractical because of lack of cooperation in its application except under general anesthesia.

Extralaryngeal surgical procedures, caustics, strong electrocautery, and roentgen therapy have no place in the treatment of laryngeal papilloma in children. The disorder is self-limited, and tumor growth subsides before the age of 10 years in most instances. Therefore optimum treatment is conservative, to insure future normal voice.

426 17th St.

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A New Concept of Nasal Bone Grafts

EDGAR M. HOLMES, M.D., Boston

Several years ago, I devised a method of forming and inserting a bone graft into a nose which would correct lost support of the dorsum and maintain elevation of the tip without resorting to the use of a columella strut. Describing the method to several of my colleagues, they persuaded me to publish the procedure. Before describing the principles and techniques employed, the general subject of the saddle nose and its correction will be briefly reviewed, as it has a direct bearing on the subject.

Fortunately, the "saddle back" nose caused by syphilis is of infrequent occurrence today. That statement is made because it is a difficult deformity to correct, as not only is the skeletal support missing but frequently skin and mucous membrane has been damaged and contracted in the early, destructive process, which necessitates creating a skin covering and a mucous-membrane lining before resorting to a graft.

The commonest cause today of the saddle nose is direct, violent trauma in which the nasal bones and septum are comminuted and collapsed, thus lowering all support to the dorsum. If these cases are seen early, it is usually possible to realign the fragments of the nasal bone and septum and maintain them in position until healed. When this is not done, the fragments of bone and septal cartilage are organized in a firm mass which is nearly impossible to free up, elevate, and hold in position. When this is encountered, it becomes imperative to insert some material between the depressed skeleton and the overlying skin in order to restore contour. This has been an operative procedure for many years, and the materials employed for implants have been many. Both inorganic and organic materials have been used. Gold and silver were tried; then to have something lighter and more like bone, ivory was shaped and inserted. About 25 to 30 years ago, paraffin was quite in vogue. Being a material which could be readily injected beneath the skin and shaped while it was molten, it would solidify, holding the form that it was given. With the advancement of metallurgy, an alloy known as Vitallium was developed, which was completely inert when buried in the tissues. Then came the element tantalum and, more recently, some of the chemical compounds, such as polyethylene and the acrylics. All of these materials have been employed with more or less success. The rigid materials are frequently retained and fulfill their purpose for some years, but most of them eventually set up a foreign-body reaction or erode through the skin because of a slow pressure necrosis. With all the failures that were encountered in the nonliving materials, the viable transplants were surveyed to determine which was the most desirable. Wherever one can replace a lost substance with like material, one has accomplished the ideal restoration. Autogenous cartilage, if available and taken from the septum, is acceptable because it will not curl and is retained as a viable transplant. When borrowed from the rib and buried in the nose after it has been shaped to fill the defect, it has a tendency to change shape. To overcome this drawback, cartilage has been diced or grafted into small particles which were

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From the Department of Plastic Surgery of the Massachusetts Eye and Ear Infirmary.

inserted beneath the skin as a homogeneous mass. This works well in the hands of the surgeon familiar with the technique; yet, in other hands, the results have been discouraging. Homologous cartilage which has been preserved fulfills most of the requirements, except that it has a tendency to be replaced by fibrous tissue, which, in turn, may contract and disappear, resulting in the complete loss of the graft. Autogenous cartilage does not do this, as it remains a living material. In certain cases where we need considerable bulk not only to fill in the depression of the dorsum but also to maintain elevation of the tip, it has been found that bone fulfills the necessary requirements. Even bone which may become a living, integral part of the tissues may change shape because of the stresses and strains of the tissues over it, but, on the whole, this change is minimal.

Bone may be taken from the host from many sites, but the one which is not only easiest for the surgeon but most convenient from the patient's point of view is the iliac crest. Here any amount of cortical and cancellous bone may be obtained without interfering with the appearance or function of the part involved. Should we wish to use homologous bone from a bank, this may be used with gratifying results, but it is a dead material which must first be decalcified and then replaced by new bone cells which invade from the host. It merely takes longer for the finished result. If the bone is not adherent to living bone, it will be absorbed.

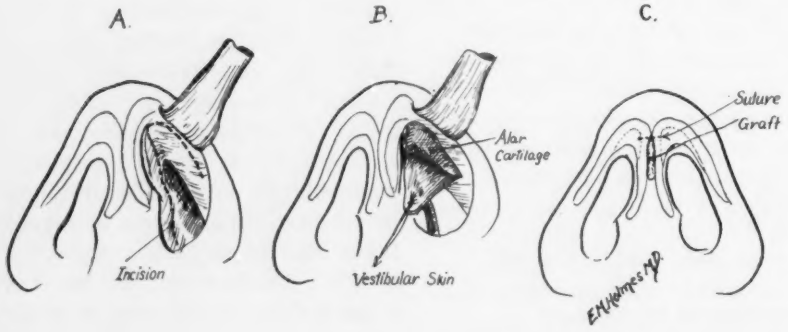
A good graft to fill in a large defect in a nose is, therefore, autogenous bone taken from the iliac crest. This may be shaped so as to completely fill the space created by elevating the skin from the nasal bones and cartilages. When properly inserted, it will maintain an elevation of the tip without the use of a columella strut. The only drawback to the graft is that it becomes an integral part of the nasal framework, is rigid, and, by being firm, it may annoy the patient. The majority of people become quickly adjusted to it, and the only thing they must be concerned about is banging the tip of the nose, creating a fracture of the graft. Should such a fracture occur, the tip fragment may be held in proper elevation until it is reunited. Should the fracture not be attended to, the tip droops, presenting another problem which must be met.

Now that we have covered briefly the problems of nasal grafts and where we know that bone gives us a satisfactory result in large defects, allow me to present a method

Fig. 1.—*A* illustrates the vestibular incision. It parallels the anterior margin of the alar cartilage, being about ⅛ in. from it. At the apex, it carries posteriorly to the posterior margin of the alae, where it is then carried through the columella as a transfixation incision.

B, the skin of the vestibule is dissected from the undersurface of the alar cartilage to the lateral cartilage. From there on, the dissection is carried beneath the perichondrium to the nasal bones, where the periosteum is then undermined up to the glabella.

C illustrates the insertion of the bone grafts between the medial crura of the alar cartilages, which are then sutured over it.



which has proved gratifying in constructing and inserting such a graft. The graft should not only give us proper support of the dorsum of the nose but should maintain support of the tip without a columella strut.

OPERATIVE PROCEDURE

In operating on these cases, the choice of anesthesia depends entirely upon the operating surgeon, but local anesthesia has been found to be quite practical and, to me, the anesthesia of choice. There may be some discomfort to the patient when the iliac crest is exposed, but this can be avoided by the administration of thiopental (Pentothal) sodium at this stage of the operation.

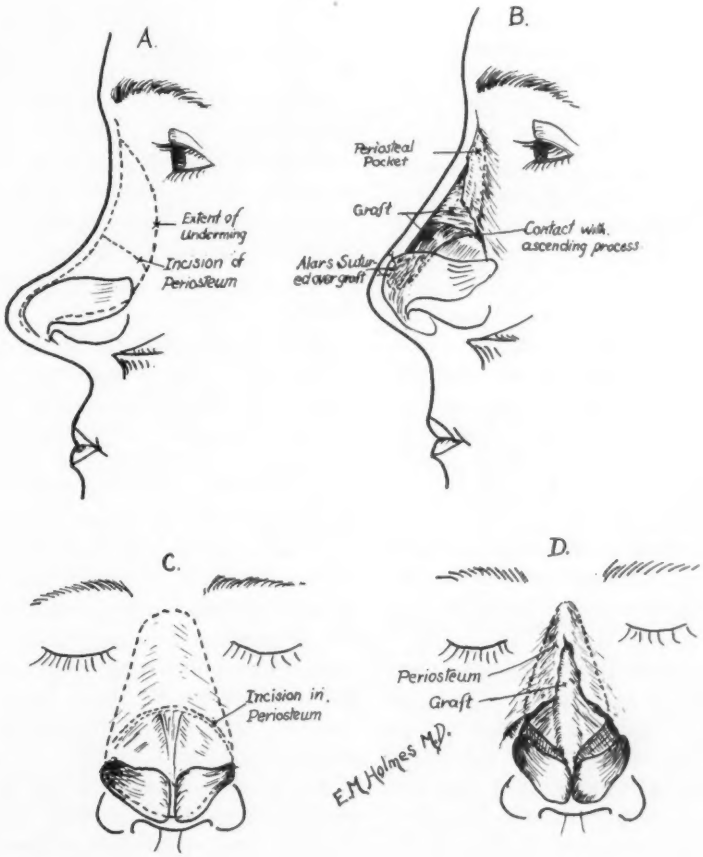
There are several incisions through which the dorsum of the nose may be approached to prepare it for the reception of the graft. Incision through the skin of the nasal tip or columella creates a direct view of the dorsum which is ideal surgically, and yet it may be difficult to obtain an opening sufficiently large to permit passage of a large

Fig. 2.—*A* illustrates the extent of undermining of the skin.

B shows the graft in place. It must be beneath the periosteum at the glabella and resting in contact with the nasal bones or ascending process throughout its undersurface. It will be observed that the alar cartilages are held up over the tip of the graft by sutures. The tip is held in place by the cantilever action of the graft, thus avoiding the use of a strut between the premaxillary spine and the tip of the graft.

C demonstrates the extent of undermining.

D, same discussion as for Figure 2*B*.



graft, which must be used in some cases. In addition to this, it leaves a varying degree of visible scar. In order to overcome these objections, I have found the following approach more satisfactory.

An anterior incision is made through the vestibular skin parallel to and ⅛ in. from the anterior margin of the alar cartilages. When the medial crura are reached, the incision is directed back to their posterior border and carried through and through as a transfixion incision (Fig. 1). The vestibular skin is then dissected free from the lateral crura of the alar cartilage up to the lateral cartilages themselves, which are then exposed up to the nasal bones. An incision is then made parallel to the pyriform aperture through the periosteum, which is then elevated from the nasal bones up to the glabella (Fig. 2). The median raphe must usually be cut to permit elevation of the periosteum in the midline, but in its upper third in the region of the glabella it is almost always possible to create a pocket which is to receive the upper end of the graft (Fig. 2*B*). The nasal periosteum is then elevated laterally down over the ascending processes to permit the skin to form a normal-appearing side of the nose. The medial crura of the alar cartilages are freed from one another by employing blunt dissection. This step is important, as the medial crura are sutured over the graft at its tip, and will be dealt with later (Fig. 1*C*). If it is apparent that the columella should be brought forward, it is advisable at this stage to continue the dissection of the medial crura of the alar cartilages down through the soft tissues to the region of the premaxillary spine. In this pocket, a graft may be placed. It may also be advisable to make a pocket in the free border of the septum as well. The nose is now ready for the reception of the graft.

To obtain the graft, the crest of the ilium is exposed from the anterior spine backward for 4 to 5 in. by using an incision curved downward. This curved incision makes the exposure easier and prevents a straight-line contraction scar postoperatively. The periosteum is incised on the lateral aspect of the crest for at least 3 in. or more, depending on the length necessary to obtain the required amount of bone. If the periosteum is elevated from the crest and carried not only externally but internally as well, a good portion of the bone is exposed. Some operators object to this wide exposure of the crest, maintaining that it is not necessary and stating that sufficient bone may be obtained by removing a wedge from the crest downward between the inner and outer face. This does not give sufficient bone for the graft under discussion, and there is no reason why the exposure mentioned should cause any permanent disability. There may be slightly more discomfort for a few days, that is all. The exposed bone is now studied to determine the best area and way in which it may be shaped. With a thin, broad osteotome, the cortex is sculptured in situ to form the exact contour desired to produce the dorsal support. It is very easy to tool in this position, as it is completely immobile. Once the dorsum and the bone which will correspond to the sides of the nose and even lost ascending processes is sculptured, it is removed as a block of bone, taking a good margin of bone in all directions with it. If there is a possibility that we may wish to use bone to fill out the columella, this may be taken at this time. All bleeding is then controlled and the wound closed.

Once removed from the ilium, the bone is then tooled with a rongeur and rasps, or a motor-driven burr if one wishes, so that the finished product will completely fill the defect into which it is to be inserted. If any groove or space is left between the graft and ascending processes, it will cause an external depression in that area when the skin is pulled in after healing is complete. If we are unable to tool the graft exactly, bone chips or cancellous bone may be used to fill in these small areas, but, when possible, we like to have the graft fill in the entire defect itself. This can best be visualized by referring to the diagrams (Figs. 2 and 3). The solid upper half of the graft is carved so that it will rest securely upon the nasal bones. Great care is taken so that its upper end will insert into the

pocket at the glabella, which should hold it firmly in contact with the bone. The lateral wings of the graft will then rest either upon the nasal bones or the ascending processes and, in turn, by its cantilever action will support the tip. This principle avoids the necessity of using a columella strut. The graft from its contact with the lower border of the nasal bones is then tapered gradually until it comes to the region of the alar cartilages, where it is thinned from the lateral aspect, permitting it to come between the medial crura, which may then be sutured on top of it for support (Fig. 1*C*). This elevates the tip above the graft, giving the profile a more normal appearance. The original incisions are

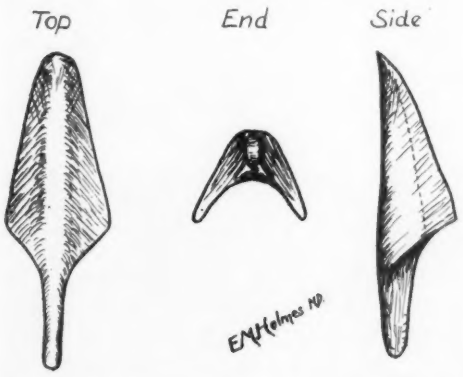


Fig. 3.—A drawing of the graft demonstrating the way it is shaped to completely fill the defect which is created by elevating the skin from the underlying, depressed bone and cartilage. Observe the way the anterior third is narrowed to take the place of the lost septum and the concavity of its undersurface so that it fits snugly over the nasal bones.

now closed, the nose packed intranasally, and a routine external pressure bandage is applied.

This type of bone graft has the advantage of being in contact with a larger surface of living bone. It is immobile, takes well, becomes an integral part of the nasal framework, and supports the tip of the nose in a more normal anatomical relationship without resorting to a strut of bone between the anterior premaxillary spine and the undersurface of the tip of the graft. If the columella needs to be more prominent, a piece of bone may be inserted for that purpose, but not to act as a support for the tip.

The photographs illustrate three cases, each presenting a slightly different problem. The discussion of each case is given.

REPORT OF CASES

CASE 1.—This patient had a congenital defect with little nasal bone development and a marked rounding of the alar cartilages associated with practically no columella. Earlier in life, she had been operated upon by another surgeon, who had inserted conchal cartilage from the auricle to the tip over the alar cartilages, anticipating that growth might be stimulated. This may have had some effect, as the tip did seem to grow a little more than the rest of the nose. The columella was constructed by using bilateral flaps swung from the upper lip. In 1950, a bone graft was employed as described in this article, but in addition to it a thin strip of bone was placed within the columella to permit it to be lowered so that it could be seen from the lateral view.

CASE 2.—This woman had received facial injuries at the hands of an invading army. The facial bones were badly displaced and with them the nasal bones and ascending processes were pushed backward. Because of the marked comminution, it did not seem advisable to attempt to free the bones and bring them into proper alignment. In place of that, a bone graft was employed. Note in the front view that the flaring alar cartilages which were present preoperatively have been narrowed. This was done by suturing the alar cartilages over the graft in the midline and by breaking their spring at their apices and again 2 to 3 mm. laterally. The marked depression at the glabella has been corrected and the tip elevated slightly.

CASE 3.—This patient received an injury as a young boy, and it will be noted that the nasal bones have been pushed laterally and are depressed, the tip slightly drooped. Our problem here was not only to improve the dorsum but to first correct the deviation of the nasal bones so that the graft could rest in the midline. At the operation, the nasal bones were first exposed and then the left one, which was prominent and angulated, was freed and brought into position. The grafting procedure was then carried out according to plan. It will be noted that the dorsum has been elevated and the alae brought into a more normal position.

SUMMARY

It has been found that this method of forming and inserting a bone graft to elevate the dorsum of the nose has proved satis-

Fig. 4 (Case 1).—Views before and after grafting.

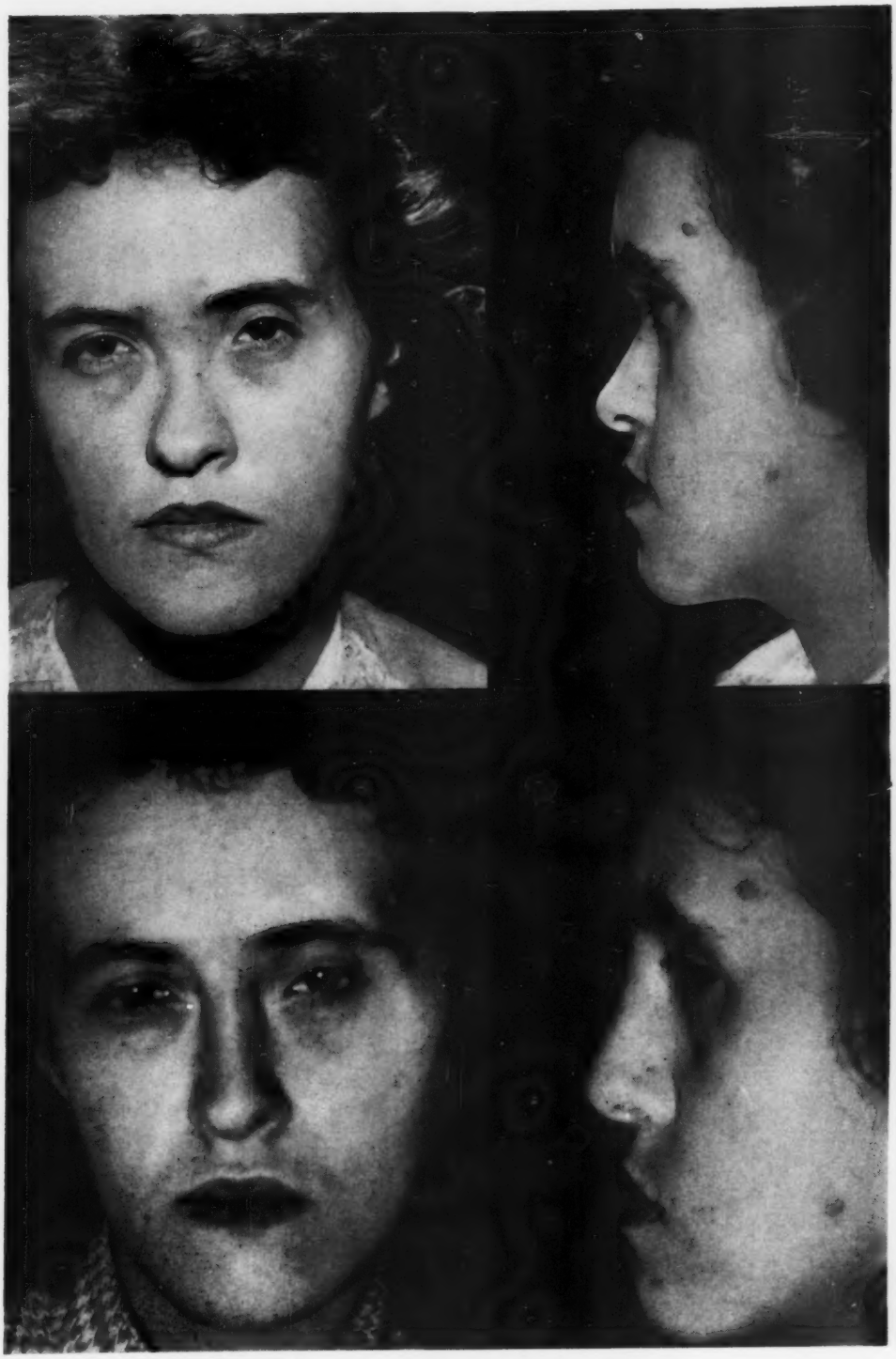


Fig. 5 (Case 2).—Views before and after grafting.

Fig. 6 (Case 3).—Views before and after grafting.

factory. It completely fills in the void left when the skin is elevated into position, thus eliminating irregularities which are frequently visible beneath the skin on the lateral aspects of some grafts. It maintains the tip in proper relationship to the dorsum and avoids the use of a strut between the tip of the graft and the premaxillary spine. The use of the vestibular, transfixion incision avoids external scars.

330 Dartmouth St.

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Cervical Fistula Associated with Unilateral Congenital Aural Atresia

P. E. IRELAND, M.D., F.R.C.S.(C)
and
D. P. BRYCE, F.R.C.S.(C), Toronto, Canada

Congenital atresia of the external auditory canal is always an interesting problem in diagnosis and treatment. A recent case exhibiting unusual features is the stimulus for this presentation.

In order that the rather unique features which were presented in our case may be explained, a brief review of the normal development and anomalies of the external and middle ear will be discussed. This will be followed by consideration of the somewhat controversial clinical problem of the indications for surgical treatment. Finally, a case of congenital atresia is reported, with recurrent cervical abscesses over a period of many years, which was cured by operative treatment.

Embryology of the Development of the Ear

The development of the ear is best considered in two parts: first, the internal ear, and second, the middle and external ear.

Internal Ear

For the first, the ectodermal auditory placode which gives rise to the inner ear forms the auditory vesicle about the 15th day and sinks into the mesoblast. In the second month this is surrounded by cartilage, and is completely formed by the sixth month. The development of the inner ear is independent of the remainder. This is substantiated clinically in that maldevelopment of the middle and the external ear is seldom associated with abnormality of cochlear or semicircular canals. The deafness of congenital atresia is usually of the conductive type, and this is particularly challenging to the surgeon trained in the fenestration technique.

Middle and External Ear

As opposed to the inner ear, the development of the middle and external ear is complex and the result of the intimate association of several components. The structures concerned in this development are essentially the first and second gill arches and the first gill cleft. These, along with the other three arches, form the primitive pharyngeal floor. The dorsal portion of the pharynx in this area becomes gradually pinched off by the growth forward of the third arch and becomes the tubotympanic recess, which retains its connection with the pharynx along with the first cleft, which will be the Eustachian tube. In the first arch is developed a cartilaginous bar from which the mandible is formed ventrally and the malleus and incus laterally in relation to the expanding tympanic cleft. From the surface there is an inpouching at this point and a meatal cord of ectoderm grows in to approximate the developing malleus, thus the malleus is pinched between the ectodermal cord laterally and the tympanic cleft medially. The tympanic bone, another first-arch structure, is laid down in relation to the ectodermal cord, which by its canalization will produce the drum and external canal. In the second arch is developed a cartilaginous bar from which will be formed medially the short process

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From the Department of Otolaryngology, University of Toronto.

of the hyoid bone and more laterally the styloid process and stapes.

The cartilaginous bars by virtue of the mesodermal development lie outside the tympanic cleft. As a result of mesodermal thinning and endodermal budding, the derivatives of these bars become lined with entoderm and appear within the cavity. As in the canalization of the gastrointestinal tract, the cord of ectoderm lying in the position to be taken up by the external auditory canals is hollowed and thinned to form a tube which connects with the dimple externally and the tympanic cleft internally. Its internal extremity expands to form a plate which will eventually thin to form the drum membrane. The final feature of development is seen after birth when the tympanic bone extends laterally as the external bony canal except for its roof, which is a result of a similar expansion laterally of the temporal squama. The auricle itself is the result of the molding of six cartilaginous mounds grouped about the primitive external canal. Such a picture illustrates clearly the interdependence and complex relationship of the structures which go together to make up the middle and external ear.

ANOMALIES IN DEVELOPMENT

It is not surprising that with relative frequency the otologist is faced with a maldevelopment of the ear. Clinically the variations are a matter of degree, and it appears that the orderly process of development stumbles most frequently in the later and more complex stages. The middle-ear cleft is usually present, but the external canal and the structures which go to make up the drum may present abnormalities. The tympanic bone is a key structure. It may commonly be completely or partially absent, and in such a case there will be a deformity not only of the external canal but also of the middle ear. The middle ear may be narrowed from front to back and indeed the styloid process may fuse across it to the mastoid process, thus causing bony obliteration of the external canal. In such a case there will be few normal landmarks and the facial nerve in particular will be out of place. In lesser degree only part of the tympanic bone may be present with membranous atresia of the canal and absence of the bony anterior wall and floor.

The tympanic ring is associated with the second key step, which is the canalization of the ectodermal cord to form the drum and external canal. Failure of this process will result in a membranous atresia and the absence of the drum in a varying degree, and probably also have a bearing on the development of the tympanic bone. The ossicles are usually present but, with maldevelopment of the drum and external canal, are deformed. The malleus is commonly vestigeal and the incus deformed, and frequently the two are fused. The Eustachian tube, a relatively primitive structure, is almost always present and patent.

The auricle presents a variety of deformities from absence to minor variations in the structure of the cartilages. Its development would appear to be late, and although a deformed auricle may often be present with an otherwise normal external canal, it is almost always present when the middle ear is badly disrupted. The correction of auricular deformities is a cosmetic rather than a functional problem.

INDICATIONS FOR SURGICAL TREATMENT

The otologist is faced most often with a unilateral abnormal ear in which the patient has very little hearing. With a grossly deformed auricle the most pressing problem is probably the correction of this abnormality so that the patient is relieved as much as possible from the psychic strain of an obvious deformity. In most unilateral cases, the improvement of hearing which might result is not sufficient to justify the extensive and often hazardous surgery involved in correction of the atresia. The technical difficulties are particularly great when the atresia is most complete and, in particular, when the middle ear is obstructed by a plate of bone. Here there are no landmarks to help the operation and the facial nerve is very easily damaged. In bilateral cases in which the

hearing is not good enough or in unilateral cases in which the good ear is threatened, the operation is justified, and will result in some cases in marked hearing improvement. Occlusion of the oval and round windows with scar tissue is sometimes seen in marked atresia and will interfere with the operative result.

Aside from rebuilding of the auricle and efforts to improve the hearing, operation may be indicated because of infection in the isolated middle-ear cleft. The operation cannot be expected to do more than construct an opening to expose the medial wall of the middle ear and by one method or another keep the newly constructed meatus open. A drum membrane of any value will not be found nor has a useful one been constructed. The work of J. S. Fraser in 1931 [1] and L. R. Richards in 1933 [2] and the more recent presentation of F. Altmann [3] should be consulted by anyone interested in a full discussion of this problem.

REPORT OF A CASE

In March, 1930, a white girl, aged 7, was admitted to the surgical service of the Hospital for Sick Children, Toronto. She presented an inflammatory mass in the left side of the neck which pointed about 2 in. below the mastoid tip and 1 in. behind the mandibular ramus. A diagnosis of infected branchial cyst was made, and the abscess was opened and drained. Methylene blue injected into the fistula appeared in the mouth. When probed, the fistual tract ended against the base of the skull.

There is no further record of this patient until she was seen by one of us (P. E. I.) and admitted to the Toronto General Hospital in April, 1950. She gave a history of almost constant foul discharge into her nasopharynx, particularly with upper respiratory infections. At times this discharge would stop and there would form an abscess in the neck, which would break through and discharge. On her April admission the presenting abscess was again opened and drained and it was felt that the fistula led toward the middle-ear cavity and base of the skull. At this time, it was noted that there was a complete congenital atresia of the left external auditory canal, a condition not previously mentioned, and it was felt that the middle ear might be the source of the infection.

X-ray studies indicated a normal inner ear and destruction in the region of the middle ear, but were not conclusive as to the presence of a bony external canal. The iodized oil (Lipiodol) studies were not helpful. The right ear was considered normal, and its hearing was within normal limits. On the left side the bone conduction was not reduced, but there was no demonstrable hearing present by air conduction. Turning tests demonstrated a normally reacting left labyrinth.

The patient was discharged for further observation. Abscesses recurred in September and October, 1950, and it was decided that operative treatment was advisable to open the left middle-ear area in the hope that the source of the infection could be isolated and drained.

At operation through a postauricular incision, the posterior bony canal wall and Henle's spine could be identified. A large mastoid antrum was entered, and this led to a middle-ear cavity lined by granulations. A large deformed incus was seen, but no malleus or drum was found. The middle-ear cleft itself was not grossly abnormal. Extending laterally from the middle ear for a distance of about ½ in. was the simulation of an external canal which formed, with the middle ear, a large granulation-lined cavity. The floor of this cavity was open into the neck because of the complete absence of the tympanic bone. The mastoid process, ramus of the mandible, and styloid process were present and not abnormal. It was obvious that the middle-ear cavity communicated through the floor

of the external canal with the region of the cervical abscess.

The atretic canal was removed in its entirety and the meatus formed by an endaural incision combined with a posterior T-incision. The cavity was then packed widely open. Postoperative care was uneventful. A large dental composition stent was finally left in place for four months until epithelization was complete and further scar contraction unlikely. This patient has remained free from further neck infections for over four years and has a well-epithelized dry cavity, which is free from discharge.

COMMENT

This case was of particular interest because of the association of chronic otitis media with congenital atresia of the ear. It demonstrated also an unusual cause for cervical abscess and fistula.

The atresia in this case was not severe but involved the two key structures in development, the tympanic bone and the external canal. The absence of the annulus tympanicus and tympanic bone supports the diagnosis of congenital, rather than acquired, atresia. The middle ear and its associated structures were relatively well formed otherwise. It is interesting to consider whether the medial cavity in the external canal was the result of the disease associated with the middle ear or an incomplete canalization of the embryonic ectodermal cord.

The history of foul discharge into the nasopharynx supports the conception of a patent Eustachian tube draining the diseased middle ear. In the presence of inflammatory swelling this drainage pathway would block and the discharge would be forced through the deficient floor of the external canal into the neck and thus form a cervical abscess. This case also illustrates one of the few quite rare but absolute indications for operation in these cases.

SUMMARY

A case of congenital atresia of the ear is presented in which the middle-ear cleft became recurrently infected and drained spontaneously through a cervical fistula continuous with a dehiscence in the floor of the canal.

This presents unusual features in that it was primarily due to a failure of development of the tympanic bone.

The patient had a period of 20 years of recurrent cervical abscesses, which were erroneously diagnosed as having their origin in a branchial cleft cyst.

The operation was relatively simple due to the presence of the ordinary landmarks for mastoidectomy and the presence of middle-ear cavity.

This case presents one of the rare indications for surgical interference in unilateral congenital atresia.

Room 82, Banting Institute, 100 College St.

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Pulsion Diverticula of the Hypopharynx

WILLIAM R. JOHNSTON, M.D.
Santa Barbara, Calif.

INTRODUCTION

During the past 10 years, numerous references to pulsion diverticula of the hypopharynx have appeared in the current literature. Further discussion of the subject at length would seem superfluous except for the fact that the surgical repair of these lesions has been assumed to be the prerogative of the general surgeon. It is my contention that such diverticula present no unusual difficulty to the otolaryngologist who is conversant with neck surgery, and should be considered a part of his repertoire in the same sense that branchial and thyroglossal cysts have for years been so considered. The otolaryngologist adept in the performance of laryngofissure and, particularly, laryngectomy will find removal of pulsion diverticula a clear-cut, logical bit of anatomical dissection in a field which he already knows intimately.

NOMENCLATURE

King [1] classifies esophageal diverticula into three distinct and unrelated types: Supradiaphragmatic lesions are rare and are generally considered to be the result of inflammatory or mechanical obstruction at the cardia. Diverticula of the midportion have been long known to be of traction origin rather than pulsion, and are almost invariably associated with adhesive traction from inflammatory lymphadenopathy in the mediastinum. The lesion by far the commonest, the one which we are considering, is the typical pulsion diverticulum, whose exact location has long been a subject for dispute. Consensus of more recent opinion places the orifice of the lesion on the exact borderline between esophagus and hypopharynx, and the term "pulsion diverticulum of the hypopharynx" seems to be most widely acceptable.

To illustrate the understandable confusion in the nomenclature of these lesions, as well as a parallel confusion regarding their true location, Perzik [2] includes in his most comprehensive bibliography a complete list of synonyms. A few are quoted herein as a matter of historical interest:

pharyngeal diverticulum
pharyngo-esophageal diverticulum
esophageal diverticulum
pharyngeal pulsion diverticulum
pharyngeal pouch
pharyngo-esophageal pouch
hypopharyngeal diverticulum
retrocricoid pharyngeal diverticulum
pharyngocele
Zenker's terminal diverticulum

CAUSATIVE FACTORS

Much dispute has arisen concerning the cause of hypopharyngeal diverticula. It is probable that merit exists in several of the theories and that the true cause is likely to be a compromise.

Negus [3] believes that the comparative anatomist holds the answer. A comparison of the relative position of the soft palate and the larynx in man and in the quadrupeds reveals that in the latter the two are in close proximity, resulting in a much larger nasal airway than oral. In other words, the lower animals breathe more easily through the nose than through the mouth. In man the larynx has retreated to a relatively caudad position, with a consequent widening of the oral airway. Two results of this evolution affect the origin of pulsion diverticula. First, the caudad retreat of man's larynx has stretched

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the superior and middle fibers of the inferior constrictor muscle into an oblique or fan-shaped conformation. The most inferior portion of the inferior constrictor, referred to usually as the cricopharyngeus muscle, remains horizontal or transverse as a powerful pinchcock closure of the upper esophagus. Second, the necessity for a strong muscular closure of the esophagus during violent exertion of the thorax and upper extremities is, in man, the result of the wide patent oropharynx. Without a powerful esophageal closure, such violent exertion would permit ingress of air into the esophagus. Negus thus believes that evolution has endowed man with a thin vulnerable area between the oblique and transverse portions of the inferior constrictor muscle, which under proper circumstances may become a true hernia.

Numerous authors cited by Perzik believe that in addition to the thin site of predilection some sort of disturbance of the reflex arc, with resultant incoordination in the swallowing mechanism, is necessary.

King advances the idea, by no means in conflict with the foregoing, that the thin site of predilection, while an anatomical potentiality, does not actually exist unless pressure atrophy intervenes. He feels that the well-developed cricopharyngeus muscle in man holds the cricoid cartilage into such firm contact with the fifth or the sixth cervical vertebra as to produce an actual dissolution of the muscular covering and consequent herniation of the mucosa and submucosa. The fact that most of these lesions occur in males, with their larger and heavier laryngeal structures, adds support to King's theory. Probably the true cause lies in a combination of all three conceptions.

HISTORY

The historical background of this lesion is exceptionally well recounted by both Jesberg and Perzik in their recent monographs. By way of summary, it is interesting to repeat that the first accurate description of a diverticulum of the hypopharynx was by Ludlow, of Bristol, in 1764, in a letter to William Hunter. Believing the lesions to be a "scirrhous contracture" from syphilis, he administered half a pound of metallic mercury by mouth. On the 13th day the patient died and the mercury was recovered, not from the stomach, but from a remarkable pouch, which Ludlow sketched beautifully at autopsy. The drawings are strikingly similar to those published by Brien King in 1946. Bell in 1816 noted that the sac is a true hernia, devoid of muscular covering. In the early days treatment consisting of bouginage in an effort to dilate the supposed stricture and later, when the true nature of the obstruction was better understood, of cautery to the sac with various escharotics.

More than a hundred years after Ludlow's original description, Nikoladoni, in 1876, attempted the first surgical approach by external fistulization of the sac. Gradually attempts were made to extirpate the sac after marsupialization, in much the same manner as the classical two-stage approach, but always with fatal termination because of sepsis. Our first records of successful removal of these pouches began to appear in the late 1890's, and with the advent of aseptic technique, about 1910, mortality statistics receded to a fairly reasonable 20%. Our current era of antibiotics and antimicrobials finally brought surgical treatment of diverticula of the hypopharynx into the realm of definitive surgery.

SYMPTOMATOLOGY AND DIAGNOSIS

The symptoms of diverticulum which bring a patient to his physician are variable but usually suggestive. In a few instances, dysphagia may precede herniation by months or even years. In these persons it is reasonably conjectured that a neurological incoordination of deglutition is the inciting factor. As a rule, however, dysphagia occurs only late, when the redundant sac becomes the primary recipient of food and liquids and drags the true esophageal aperture into a narrow constricted position which permits only a trickle of overflow from the sac to enter the esophagus. Before this drastic situation has been attained, however, the patient has usually sought assistance because of regurgitation

and violent attacks of nocturnal choking. Often he will have noticed that by lying in a certain position and exerting pressure on his neck he can empty the sac almost at will. A careful history will usually make the diagnosis almost certain, subject to confirmation by esophagram. Sometimes, but not always, the crepitant sac full of fluid and air can be palpated in the neck, and at times a bizarre gurgling sound will be described by the patient when he swallows.

X-ray examination with opaque media in both anteroposterior and lateral positions will give invaluable information to the surgeon. The sac is usually single and located to the left of the midline, posterior to the esophagus. Multiple diverticula have been reported as a rarity, and Jesberg [4] recently reported a bilobed sac with a single hypopharyngeal orifice. In a clear-cut lesion whose orifice and location can be well demonstrated by x-ray, esophagoscopy is not necessarily indicated, and, in fact, is considered by some authors to be an unjustifiable hazard. Jackson has cautioned that endoscopic approach to these blind pouches is fraught with danger of perforation. The sac is usually very thin and fragile. If, however, the lesion is peculiar in shape or location or there is any doubt about which side to approach, endoscopic examination is important, and may simplify subsequent surgical treatment. As a general rule, the insertion of an esophagoscope prior to or during surgery is not necessary and may be actually undesirable. Perzik feels that if the lesion is so small as to present a problem in location, it is best not disturbed until it exceeds 2 cm. in length or is definitely symptomatic. Very small diverticula are usually found accidentally during gastrointestinal roentgenology, and may not become symptomatic for years. Conversely, however, a patient should not be subjected to watchful waiting until the sac descends to the level of the aortic arch and he has become an emaciated surgical risk.

TREATMENT

Modern concepts of treatment of diverticula of the hypopharynx resolve to a choice of surgical methods. Prior to the advent of antibiotics, direct surgical extirpation in one stage posed the problem of risk from sepsis. As a result, such responsible surgical authorities as Halstead, in 1903, Mosher, in 1917, and McClure, as late as 1934, advocated invagination of the sac endoscopically and removal by cautery or snare. Jackson, in 1915, C. H. Mayo, in 1923, and Lahey, in 1930, urged a two-stage procedure on the grounds of safety. The sac was first dissected partly free and ligated without removal. When sufficient time for scar-tissue isolation and closure of the orifice had elapsed, the sac was removed at a second operation. All authorities recognized the superiority of a single-stage method, but not until antibiotic protection became available could such a departure from the principles of surgical safety be fully accepted.

In February, 1946, Brien T. King, of Seattle, read a paper on this subject to the Pacific Coast Surgical Society in San Francisco. His precise description of the surgical removal of a diverticulum of the hypopharynx is classical in its simplicity and logic. At no point does he differ materially with other recent writers, but he makes perfectly clear a number of pitfalls which might prove confusing to a less experienced operator.

The choice of anesthesia is not critical. More recently, thiopental (Pentothal) sodium with intratracheal oxygen has been preferred, but inhalation anesthesia or cervical block is preferred by many. If inhalation anesthesia is used, intubation should be employed, not only to insure an adequate airway but to avoid possible rupture of the sac by pressure of the anesthetic gas in the pharynx.

Unless x-ray examination indicates otherwise, King routinely enters the neck along the anterior border of the left sternocleidomastoid muscle. In this initial incision, Perzik and others prefer the transverse supraclavicular incision because of the somewhat better scar, and because of the versatility of this latter incision if the opposite side of the neck should need to be opened. The vascular

sheath is located by blunt dissection and retracted laterally. Usually the anterior belly of the omohyoid muscle is divided and withdrawn from the field, but often it may be retracted either superiorly or inferiorly. Often it is necessary to ligate and divide the middle thyroid vein before the vascular sheath and its contents can be moved far enough aside for good exposure. The same is true for the inferior thyroid artery, where great care must be used to identify and avoid injury to the recurrent laryngeal nerve. In case of doubt, the recurrent nerve can be most easily located parallel to the posterior border of the trachea at the level of the inferior border of the cricoid cartilage. The field is now exposed and the sac should be easily located. If it cannot be readily identified, the finger can be passed behind the esophagus and gently slid superiorly in the loose areolar tissue until the neck of the sac is felt at the level of the inferior border of the cricoid cartilage.

The distal tip of the sac is grasped with a nontraumatizing clamp, at all times avoiding sufficient traction to tear the sac. In most cases, the redundant portion of the sac will be found to be thick and tough from chronic infection and irritation by the contents. Dissection of the sac may be easy or quite tedious, depending upon the amount of inflammatory reaction which has previously occurred. As the neck of the sac is approached, it becomes exceedingly thin and delicate, and care must be exercised to avoid lacerations when the muscle fibers covering the neck are teased aside to expose the submucosa. King is careful to remind us that the orifice of the sac in its anatomical position is a transverse slit almost the full width of the esophagus. At this point he also calls attention to the rolled-up bundle of muscle fibers over which the neck of the sac is sharply angulated as it lies parallel to the esophagus. With the patient's neck rotated to the right and the left border of the larynx elevated with a hook, the sac is drawn laterally and thus easily exposed. It is closed with a narrow hemostat of the Rankin type, as close as possible to the esophagus and in a transverse position. A second hemostat is placed close to the first and the neck of the sac divided between the two. The closed lips of the stump are cauterized either electrically or with a touch of phenol and then approximated with a running 00 chromic absorbable surgical (gut) suture on an atraumatic needle around the hemostat. When the suture is loosely completed, the hemostat is carefully withdrawn and the suture pulled tight and tied. Care must be used to avoid puckering the line of closure. A second line of either continuous or interrupted sutures is then placed so as to infold the first line. At this time it is well to thin out the previously mentioned bundle of muscle fibers just below the neck of the sac and utilize them to reinforce the esophageal closure, in order to prevent the formation of a ridge or shelf which might predispose to recurrence of the hernia. All structures are allowed to fall back into place; the incision is closed over a small Penrose drain, whose upper end must not be placed too close to the suture line in the esophagus.

Postoperative care consists of liquid feeding as soon as tolerated, progressing to soft diet on the 5th day and regular diet on the 10th to the 14th day. Some surgeons prefer to use a small feeding tube for the first three or four days or to depend entirely on intravenous fluids for the first 48 hours. The drain should be removed in two or three days.

REPORT OF A CASE

J. L., a 71-year-old man, was first seen in our office on March 28, 1952, with the classical symptoms of diverticulum of the hypopharynx: regurgitation, nocturnal choking, severe weight loss, and difficulty swallowing. His symptoms had begun following an inguinal herniorrhaphy in 1949 and were gradually becoming worse. An esophagram (Fig. 1) taken elsewhere a year before we saw the man showed a fairly large pouch lying mostly to the right of the midline. Our recheck films indicated that the pouch had somehow migrated to the left side while becoming larger, and now lay in the position most commonly observed. Because of the absence of any unusual or confusing factors in the case, esophagoscopy was not done.

On April 24, 1952, a large firmly adherent diverticulum was removed according to the technique as outlined by Brien King. Intratracheal nitrous

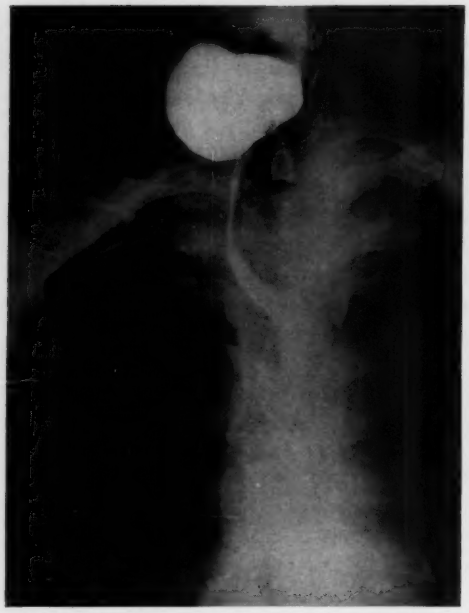

Fig. 1.—Esophagram showing pouch located well to the right.

Fig. 2.—Lateral view of cervical region taken one year after the anteroposterior view shown in Figure 1.

oxide supplemented by thiopental sodium gave excellent smooth anesthesia. No unusual situations were encountered, and the surgery proceeded in exact accordance with King's description.

Fig. 3.—Esophagram taken seven months after surgery showing complete absence of pouch.

The patient's postoperative course was uneventful. The drain and the feeding tube were removed on the second and fourth days, respectively, and liquid diet was begun. He was discharged on the seventh postoperative day on an adequate soft diet. At no time was there the slightest interference with swallowing. Our last check-up esophagram in November, 1952, showed no trace of the diverticulum and no narrowing of the hypopharynx or esophagus.

COMMENT

The case report submitted herein of surgical removal of a diverticulum of the hypopharynx presents no unusual features or complications. The surprising shift of the pouch from right to left during the year prior to its removal might be explained on the basis of expansion in the direction of least resistance. This illustration of the uncertainty of exactly locating some of these pouches serves to substantiate Perzik's preference for the transverse incision, and it indicates the desirability of an esophagram immediately prior to surgery or even endoscopic examination if any doubt exists.

Numerous references in the literature indicate the differences of opinion regarding origin, nature, and treatment of these diver-

ticula are recently resolving in general agreement, especially in favor of a simplified single-stage surgical extirpation. The almost exclusive appearance of these references in general surgery publications should suggest to the otolaryngologist interested in neck surgery that he may be unnecessarily depriving himself of a most stimulating and satisfying bit of surgery which is fully within the scope of his own specialty.

1515 State St.

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Complications and Postoperative Care After Tracheotomy

F. JOHNSON PUTNEY, M.D., Philadelphia

Since there has been an increase in the indications for tracheotomy, objective analysis of the available facts concerning complications should be made. During the past 10 years tracheotomy has taken the general direction of more frequent, earlier, and at times preventive therapy. In the increasing use of any method of treatment it is always necessary to guard against the tendency to dismiss material which is against one's preconceived opinions while welcoming evidence which favors it. The critical questioning attitude is an essential ingredient of scientific observation upon which progress depends. Adherence to established principles inhibits scientific and intellectual growth, and it is well to review from time to time the disadvantages as well as the advantages of an established procedure.

Gray [2] has pointed out that oxygen therapy corrects some of the tissue damage and acidosis of asphyxial changes but does not relieve or prevent pulmonary complications secondary to obstruction. Relief of the obstruction and maintenance of the airway by means of tracheotomy become necessary. Formerly tracheotomy was used only when death was imminent and a panic state existed. In these instances it was necessarily an operation of the last resort, with high mortality. Indications are such today that the procedure can be performed before this state of events occurs, and by accurate observation of the patient's clinical course it can be done as an elective procedure with safety. When called upon to see patients in circulatory collapse with pulmonary edema, it is sometimes hard to convince the physician in charge that tracheotomy in these cases is useless. Commonly there is a feeling that if the secretion can be removed from the lower bronchial tract and from the larger bronchi improvement will result. Unfortunately, most of the secretion is in the alveoli and periodic suction of the bronchial tree does not relieve the fluid accumulated in this area or the resulting lack of oxygenation.

Tracheotomy is employed in a large number of conditions; and, while the question of its necessity in such a varied list may be raised, it has proved to be the difference between survival and death in many cases. Procrastination and delay in performing the operation is hazardous to the patient and leads to more serious complications than any that may develop from the operation itself. In some instances it has been done without sufficient reason and the patient probably would have recovered anyway, although it may have hastened this development. In still other cases nothing that one could do would relieve or cure the patient, and in this type of case no benefit resulted.

It is by no means clear just how much the trauma and short-circuiting of the air current by tracheotomy with its indwelling tube affects inflammatory exudate and causes dryness and crusting of the tracheobronchial secretions. The drying effect can be overcome to a large extent by proper humidification of the inspired air, and the crusting can

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be minimized by judicious suction after irrigation with saline solution. The use of detergent agents and proteolytic enzymes provides some help but to a lower degree.

Tracheotomy is a relatively simple procedure, and the complications that develop are generally due to faulty surgical technique. Although the risks of the operative procedure are negligible, the postoperative sequelae may produce disability with subsequent long periods of treatment before recovery.

Severe and critical hemorrhage after tracheotomy has been reported, but this complication is rarely encountered except from actual tumor invasion of the trachea with erosion into a large vessel. In infants the trachea is soft and of such small caliber that unguarded incision of the anterior wall may result in cutting the posterior tracheal wall. Atelectasis and post-tracheotomy pneumonitis can be prevented by keeping the airway free from secretion while simultaneous antibiotic therapy reduces the morbidity and mortality.

The most frequent complications are mediastinal emphysema and pneumothorax. While these occur often, they are usually not present to a degree to cause concern. Pneumothorax is probably commoner than is generally believed and is found only on routine chest roentgenograms in many instances. Several authorities have explained the mediastinal emphysema on the basis of the indrawing of air into the mediastinum after incision of the pretracheal fascia by the high negative intrathoracic pressure from excessive respiratory efforts.

The air in the mediastinum later escapes through the pleura, producing pneumothorax, and the usual site has been found to be either over the thymus anteriorly or between the vertebral column and the esophagus. Rupture of the mediastinal pleura usually causes tension pneumothorax, and death results unless patency of the airway is restored and the air in the pleural cavities is removed. This complication may account for the "unexplained" deaths following tracheotomy. Dark [1] found 20 cases of mediastinal emphysema and tension pneumothorax following tracheotomy in the literature and added 2 of his own cases.

One of the reasons for the introduction of the bronchoscope or intratracheal airway before tracheotomy is to relieve the breathing difficulty before opening the pretracheal fascia and help prevent the sucking of air into the mediastinum around the trachea. This method is not absolute but is advantageous in a severely dyspneic patient who is using all the accessory respiratory muscles for breathing purposes. Not only does it help in the prevention of mediastinal emphysema but it also enables the operator to proceed with the tracheotomy in a more orderly fashion so that the technical procedure is better performed.

Advocates of the horizontal incision claim that it offers definite advantages, with a less noticeable scar, and prevents contractions sometimes associated with a midline scar. I cannot subscribe to this view and favor the vertical incision, which, in my experience, has produced no more scarring than the transverse incision and the cosmetic appearance has been equally satisfactory. From this standpoint it matters little which incision is used, for as the tissues fill in around the tracheotomy tube the scarring is minimal unless the tube has to remain in place for years. On the other hand, the chief objection to the transverse incision is that the flaps may distort the position of the tube so that it does not rest in the long axis of the trachea. The pressure from the upper flap may push the tube downward, causing the distal end to impinge upon the posterior wall of the trachea, producing partial obstruction to the airway and the formation of granulations. The lower flap may also form a pocket in which secretions collect because of inadequate drainage, fostering infection.

The most difficult complication to overcome and the one which can be most easily prevented is that of stenosis at the site of the tracheotomy. When this occurs there is delay in decannulation, and it is particularly prone to occur in infants and young children whose

tracheal rings are soft and can be easily compressed. After stenosis develops it is often necessary to dilate the trachea for a long period of time and remove granulations from the airway before the patient can be decannulized. In other instances the child must grow up around the tracheotomy tube so that the lumen is increased sufficiently to overcome the stenosis.

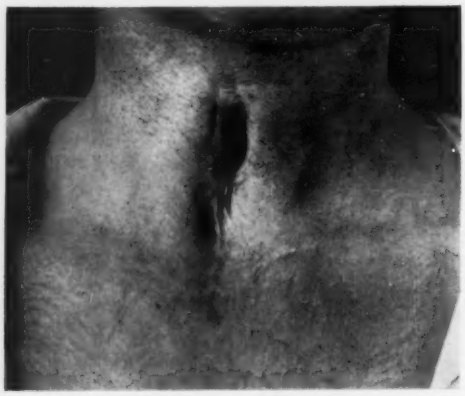
The principal cause of tracheal stenosis is tight suturing of the wound around the tracheotomy tube. This fact is not generally appreciated, and suturing is commonly employed with the idea of obtaining a better cosmetic result. Not only is this latter assumption fallacious, but the tight closure of the wound leads to the development of peritracheal infection, at times with abscess formation. During the healing process stenosis and fibrosis at the site of the tube develop. Uncleanliness from failure to change the tube daily is another contributory factor in the development of stenosis.

CASE 1.—An infant of 8 months had a tracheotomy performed for severe acute laryngotracheobronchitis. The wound was sutured tightly. After the infection had cleared decannulation could not be proceeded with because of dyspnea as soon as the tracheotomy tube was blocked. The child was sent to Jefferson Hospital for removal of the tube, and it was found that the youngster could not tolerate blockage longer than several minutes before cyanosis and dyspnea developed. On endoscopic examination of the trachea there was found a rather marked stenosis just above and at the level of the tracheotomy tube due to intrusion inward of the entire anterior wall. It was not possible to remove the tube until the trachea had developed further.

Besides the possibility of tracheal stenosis when the tracheotomy wound is sutured mediastinitis becomes more likely. There is no objection to light packing of the wound to control oozing or mild bleeding. Wound packing has been thought to prevent mediastinal emphysema by sealing off the mediastinum, but it is questionable if it has any appreciable effect on the development of this complication.

In making the opening in the trachea in infants incision of two rings, rather than removal of a segment of ring, is preferred. Although removal of a small segment of ring gives a permanent airway, facilitates the changing of the tube, and makes the tube less likely to slip out of the airway, it also contributes to the development of narrowing at the operative site, which may lead to troublesome stenosis. Removal of a portion of the cartilaginous support in a trachea which is soft with the added burden of pressure from a metal tube tends to constrict the lumen on healing. In adults with a more rigid trachea complications following excision of a portion of tracheal ring are seldom met and routine practice of this method can be followed.

It is generally appreciated that a tracheotomy performed above the second tracheal ring may lead to laryngeal stenosis, with subsequent protracted treatment necessary to overcome this (Figure). Contrariwise, sometimes in young infants the tube is placed too low so that it impinges upon the carina and produces partial obstruction of one main bronchus. In infants and young children the opening should not be made lower than the third tracheal ring. At the present time complications from low tracheotomy greatly outnumber those from high tracheotomy, particularly as regards decannulation. This indi-



After accidental injury to the neck, emergency tracheotomy was done just below the cricoid cartilage. When patient was admitted to the hospital because of inability to decannulate, the tracheotomy tube had been changed only once in 14 months. Subsequent attempt to correct laryngeal stenosis resulted in perichondritis and loss of cartilage. Final closure was accomplished by rib transplant.

cates that while the subsequent dangers of high tracheotomy are generally recognized those from low tracheotomy are not, and the dictum of tracheotomy as low as possible is fallacious.

The proper size of the tracheotomy tube for the size of the patient is an important consideration. It should rest comfortably in the trachea and not occupy the entire lumen. Granulation tissue ofttimes forms at the site of the opening, but this is more likely to occur when a large tube is inserted in the trachea rather than a tube of appropriate size for the patient. At times granulations on the posterior tracheal wall form from trauma of the distal end of the tracheotomy tube.

A factor to be considered in tracheotomized children is proper development of the larynx, and to accomplish this air must pass through the laryngeal airway. Unless the child is forced to breathe through the larynx when the tracheotomy tube is in place, laryngeal growth is retarded. This has been brought home rather forcibly in youngsters with papilloma of the larynx who were allowed to breathe exclusively through the tracheotomy tube and the larynx remained infantile in type. Even though the tracheotomy tube cannot be completely blocked off for long periods or days at a time, it is important to partially block the airway as long as tolerated so that the larynx gets a chance to function. It is much easier for the child to secure air through the short-circuiting tube in the trachea when there is laryngeal obstruction than to breathe through the larynx, so that it may be difficult to obtain cooperation in this maneuver.

The after-care of tracheotomized patients needs to be clarified both for the nursing and the general medical profession. The establishment of a tracheotomy is only a means to an end, and the operation itself does not cure the patient. It affords an accessory airway which must be kept free of secretion in order to function and provides a means of entering the lower respiratory tract to remove obstruction when it develops. It may seem elementary to mention the fact of daily changing of the tracheotomy tube. All too frequently infants are admitted to the hospital with a tracheotomy tube in place which has not been changed for 10 to 14 days.

CASE 2.—A few months ago an 18-month-old child was admitted to the hospital because he could not be decannulated. Questioning elicited the fact that the tracheotomy tube had been changed only once over a period of a month. Granulations were exuberant exteriorly about the opening and extended into the lumen of the trachea on the anterior wall. Removal of the granulation tissue, dilatation of the tracheal lumen, and establishment of cleanliness of the wound were necessary before even partial blockage of the tube could be done and subsequent removal accomplished.

It is not infrequent when visiting a tracheotomized case to find the youngster in marked dyspnea, and when the patient is examined crusting around the tracheotomy tube, with no air getting in or out of the lungs, is found. Simple cleansing of the inner cannula at stated intervals will relieve this condition. Generally, nurses are rather timid in aspirating a patient with a tracheotomy and introduce the aspirator only to the end of the tracheotomy tube. While this cleans the tube, it does not aid in clearing the lower respiratory passages. A small soft-rubber catheter introduced down to the carina and commonly into one or the other or both main bronchi is needed in many instances. It should be mentioned that frequently catheter aspiration clears only one bronchus, usually the right, since the flexible tube follows the straight route and aspiration through the bronchoscope under direct vision must be used in addition. This has been particularly evident in postoperative tracheotomized thoracic surgical cases when bronchoscopic examination revealed retention of secretion in one or the other bronchus immediately after thorough catheter suction via the tracheotomy had been carried out.

Crusting develops rather frequently, making removal of secretions difficult, but it can be facilitated by the introduction of several cubic centimeters of isotonic saline solution into the trachea several seconds before aspiration. Proper humidification and nebulization of the inspired moisture minimize this complication. Oxygen itself has a drying effect upon the mucosa of the tracheobronchial tree

and when employed should be used with some form of humidification to overcome the dryness.

CONCLUSIONS

Considering the advantages and disadvantages of tracheotomy, the former far outweigh the latter. When it is realized that the complications arise from faulty technique in the majority of cases, it would seem that this could be eliminated altogether, thus allowing for greater usefulness of this important operation.

1719 Rittenhouse Square (3).

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Juvenile Fibromas of the Nasopharynx

JOHN B. ERICH, M.D., Rochester, Minn.

Juvenile nasopharyngeal fibromas are rare and benign. There would be no need to discuss them again were it not for the fact that they produce such alarming symptoms and present such serious problems in treatment. Injudicious surgical or radiologic treatment of such lesions can cause frightening hemorrhages, intracranial disturbances, and even death. The mere removal of a small piece of tissue from this type of lesion for microscopic examination occasionally can produce bleeding so profuse that ligation of the external carotid artery and the administration of blood are necessary.

These tumors often are referred to as "nasopharyngeal angiofibromas," which is a good term in view of the fact that the vascular elements in many of these neoplasms are more prominent than the fibrous component. Juvenile fibromas arise from the base of the skull and are attached to the vault of the nasopharynx, usually by a broad, sessile base. Although they frequently grow forward into one or both nasal cavities, they rarely extend downward to be visible below the free border of the soft palate. Consequently, they seldom can be visualized except in the nasopharyngoscope or on mirror examination of the nasopharynx.

Nasopharyngeal fibromas are not malignant; they never metastasize and do not infiltrate tissues. However, they are highly destructive lesions because of their ability to cause pressure necrosis of bone and to send out processes of tumor tissue that may invade one or both nasal cavities and, in turn, the accessory sinuses. As a result, these tumors expand the nose and may enter the ethmoid cells and even extend into the orbit to proptose the eye; they sometimes invade the antrum and, in turn, may bulge the cheek, palate, or alveolar ridge. More rarely, these tumors extend into the retromaxillary fossa and even the cranial cavity.

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From the Section of Plastic Surgery and Laryngology, Mayo Clinic and Mayo Foundation. The Mayo Foundation is a part of the Graduate School of the University of Minnesota.

PATHOLOGIC ASPECTS

Nasopharyngeal fibromas are reddish firm tumors almost cartilaginous in consistency. They are rounded or slightly nodular and are covered with normal mucous membrane. Ulceration seldom is present unless the lesions have been traumatized.

Histologically, these tumors are composed of two constituents: connective tissue and blood vessels. Under the microscope, a connective-tissue stroma is seen, containing many immature fibroblasts, and coursing through this fibrous mass are thin-walled blood vessels in varying numbers. In many cases the blood vessels appear as large vascular spaces similar to a cavernous angioma. In the early development of these tumors the blood-vessel elements predominate, but in later stages the fibrous-tissue component becomes more prominent.

Fibromatous lesions in the nose, nasopharynx, or sinuses in patients in their 30's or older should not be confused with juvenile fibromas; the microscopic appearance of these two types of tumors is quite dissimilar.

CAUSATION

Fortunately, juvenile fibromas are rare. Only 130 patients with the lesion have been seen at the Mayo Clinic during the past 44 years. One hundred fourteen of these were reported on by Figi and Davis in 1950.[1] Juvenile fibromas generally are limited to the period of adolescence, beginning at the age of puberty and tending to regress after the physiologic processes of sexual development have been completed—that is, between the ages of 20 and 25 years. In a few instances, these neoplasms do persist and progress after the patient reaches sexual maturity.

The association of these tumors with adolescence naturally has given rise to the theory that they are etiologically related to a sex-endocrine imbalance. What such a relationship consists of is entirely unknown. Although there can be no doubt that such a relationship does exist, the administration of sex hormones in order to produce sexual maturity does not seem to cause regression of the tumor. Martin, Ehrlich, and Abels[2] have tried sex-hormone therapy in many cases, but they state that no definite regression of the tumor was noted in any case in which the patient was treated by sex hormones alone; they did feel, however, that the hormones reduced the vascularity of the tumors. Our limited experience with hormones in these cases has not verified these findings.

Many authors believe these tumors occur only in males. However, as previously reported by Figi and Davis,[1] five female patients with juvenile fibromas have been seen at the Mayo Clinic. Records in these five cases were thoroughly reviewed, and it was concluded that these tumors definitely were juvenile fibromas.

SYMPTOMS

In view of the fact that some patients with a nasopharyngeal fibroma complain of no symptoms for months or years, it is rather likely that these growths may be present in some persons without ever causing any symptoms. However, in most instances these tumors sooner or later produce distressing symptoms. Nasal obstruction with mucoid or mucopurulent discharge is the commonest symptom, while recurring, often severe, hemorrhages are encountered in more than half the cases. In a few patients, gagging and vomiting are annoying symptoms because of downward extension of the tumor in the pharynx. Presentation of a tumor in one or both nostrils, bulging of the nose, cheek, or palate, and exophthalmos are less frequent objective signs.

Although there are no roentgenologic changes in the facial bones that are diagnostic of this tumor, we have found in practically all cases that radiologic changes are present in the sinuses, nose, nasopharynx, or orbit.

Even though juvenile fibromas are extremely rare, the symptoms which such tumors produce are highly suggestive. When such symptoms as progressive nasal obstruction, recurrent nosebleeds, and nasal discharge occur in an adolescent boy with a firm nasopharyngeal mass, the possibility of a nasopharyngeal fibroma should immediately be considered.

There are surprisingly few other lesions which can be confused with the clinical picture produced by a juvenile nasopharyngeal fibroma. There are many tumors in the nasal cavities which may produce similar symptoms, but these tumors do not involve the nasopharynx. Choanal polyps usually are multiple, bilateral, and pedunculated, and present a different gross appearance than does a juvenile fibroma. There should be no difficulty in distinguishing lymphoid tissue in the nasopharynx from one of these firm fibromas.

However, I should like to emphasize the fact that a nasopharyngeal fibroma that is growing or is acutely inflamed may simulate the clinical picture of a malignant neoplasm and biopsy becomes necessary to differentiate the two conditions.

When any question arises concerning the diagnosis, biopsy should be performed in these cases; otherwise, it is better avoided. At the Mayo Clinic, biopsy was performed for a little more than half of the patients with

nasopharyngeal fibromas. If the diagnosis is obvious on gross inspection, it is advisable not to remove tissue for microscopic study; as pointed out previously, this procedure can give rise to profuse bleeding, which is extremely difficult to control. At times, the taking of tissue for biopsy can result in such serious loss of blood that ligation of the external carotid artery and the administration of blood are required as emergency measures. Under no circumstances should an attempt be made to secure a specimen for biopsy from a lesion suspected of being a juvenile fibroma while the patient is under the influence of local anesthesia in the office. On the contrary, intratracheal anesthesia and hospital facilities are essential, and the surgeon should be prepared to ligate one or even both external carotid arteries, if necessary.

TREATMENT

In view of the fact that the majority of juvenile nasopharyngeal fibromas undergo regression after the physiologic processes of sexual development have been completed, many physicians adopt the plan of deferring treatment in all cases of juvenile fibroma, unless the tumor is causing alarming hemorrhages. However, it must be remembered that actively growing neoplasms of this type not only can bring about hemorrhages but also can produce serious symptoms because of pressure necrosis of bone and extension to various anatomic areas, such as the nasal cavities, sinuses, orbits, or even the cranial cavity. Consequently, in any case in which the fibroma is growing or producing symptoms, there seems to be no useful purpose in postponing treatment.

In the treatment of juvenile fibromas, six types of therapy may be considered:

1. Sex hormones
2. Sharp excision
3. Electrocoagulation
4. External irradiation
5. Radium needles
6. Radon seeds

The use of sex hormones has been discussed already, and further elaboration of this phase of the subject seems unnecessary. Sex hormones apparently have no effect on the growth of juvenile fibromas, but they may possibly cause slight reduction in the vascularity of some of these tumors.

Some surgeons advocate removal of nasopharyngeal fibromas by sharp excision. However, complete extirpation of such neoplasms by this method is impracticable, even though the soft palate is divided in the midline to uncover the nasopharyngeal portion of the tumor, or the mesial wall of the antrum is removed through a Caldwell-Luc incision to expose extensions of the tumor into the nasal cavity or accessory sinuses. There are too many anatomic irregularities in the nose and nasopharynx to permit complete removal of juvenile fibromas, regardless of what surgical approach is employed. Moreover, bleeding is so profuse when sharp excision is used that it is practically impossible for the surgeon to visualize the tumor as it is being removed.

A few surgeons believe that nasopharyngeal fibromas should be removed by electrocoagulation. This form of therapy requires the use of a wire electrode which is covered, except at the tip, by rubber or some other insulating material. Such protection is essential if the surgeon is to prevent injury to normal tissues which come into contact with the electrode when it is used in the nasopharynx or nasal cavity. For destruction of that portion of the tumor in the nasopharynx, an electrode bent to a right angle is introduced through the mouth and carried up behind the soft palate to the growth; as coagulation of the fibroma is being carried out, the tumor is visualized indirectly through a nasopharyngeal mirror held in the oropharynx. Extensions of the neoplasm in a nasal cavity or sinus are destroyed through a transantral approach. Total removal of a nasopharyngeal fibroma by this method is, indeed, difficult and tedious. Occasionally, bleeding becomes so excessive that the process of coagulation becomes completely ineffective and has to be discontinued. Furthermore, when electrocoagulation is employed postoperative hemorrhages are common as the coagulated tumor sloughs away; in some instances, bleeding is

so profuse that ligation of the external carotid artery on the involved side is necessary.

External irradiation frequently has been employed as a therapeutic agent in the treatment of juvenile fibromas of the nasopharynx. It is a well-known fact that the majority of such tumors are very radiosensitive and that external irradiation does effect a reduction in their size and vascularity. However, except perhaps in a very few instances, I believe that external irradiation should not be used in these cases, because the dose of roentgen rays required to produce any demonstrable change in the size of the tumor might cause subsequent undesirable alterations (actinodermatitis) in the skin of the face.

I believe that interstitial irradiation is the most expedient method of treating juvenile fibromas of the nasopharynx. However, I do not favor the use of radium needles, simply because many of these tumors are so soft and friable that radium needles inserted in them often become dislodged by movements of the tongue and pharynx. Needles so displaced not only fail to irradiate the tumor properly but subject the surrounding normal tissue to injury. Moreover, radium needles must be removed after the desired period of irradiation has been completed; withdrawal of needles from the tumor occasionally initiates a severe hemorrhage, which is most undesirable. Such hemorrhages do not occur when radon seeds are used, for the seeds, after insertion, are not removed. Furthermore, radon seeds have the advantage of usually producing less trauma and bleeding when introduced into the tumor than do radium needles.

At present, it is my opinion that radon seeds offer the most effective form of therapy for patients who have nasopharyngeal fibromas. In addition, radon seeds, when properly employed, give rise to fewer complications than any other method of treatment. Seeds can be inserted with comparative ease and a minimal amount of bleeding. Although bleeding often is active during the introduction of radon seeds, it never is so profuse that blood must be given or ligation of an external artery is required. In the use of seeds in the treatment of nasopharyngeal fibromas, emphasis should be placed on employing a minimal number of low-intensity seeds, which never should be inserted too deep in the tissues of the vault of the nasopharynx or too close to the cribriform plate of the ethmoid bone.

Specifically, I use seeds rated at 1 mc. each. These are injected into the tumor through specially adapted spinal-puncture needles. That portion of the lesion situated in the nasopharynx is seeded in the following manner: With the patient under the influence of general anesthesia and with an intratracheal tube in place, I insert the index finger of my left hand through the patient's mouth and up behind the soft palate so that the tumor can be palpated. Each spinal-puncture needle carrying a seed is inserted through the soft palate into the tumor, where the seed is deposited. For extensions of the tumor into the nose and sinuses, seeds are inserted in a similar manner through the nostril. Should the lesion invade the cheek or retromaxillary region, seeds can be inserted by means of spinal-puncture needles thrust through the overlying soft tissues. It is of the utmost importance not to insert too many seeds in any one location, lest this result in extensive necrosis and sloughing of tumor tissue, with the probability of subsequent severe hemorrhages. I insert radon seeds about 1.5 to 2 cm. apart in fibromas of the nasopharynx; this involves the use of two to five seeds in that portion of the tumor which is in the nasopharynx and about the same number in intranasal extensions of the tumor. Although the total dose of radiation is small, it is sufficient to reduce not only the size of the tumor but its vascularity as well. At intervals of three to six months, this method of interstitial irradiation can be repeated, until the tumor has been reduced to the point at which it no longer produces symptoms. At this stage, no further treatment is necessary, even though a small nubbin of tumor still may be present. In no patient that I have treated by interstitial irradiation with radon seeds has ligation of the external carotid artery been required, and

no patient has had any serious difficulties. Furthermore, my colleague, Dr. F. Z. Havens, has arrived at the same conclusions as mine concerning the treatment of these serious nasopharyngeal neoplasms.

In conclusion, I should like to reemphasize the desirability of refraining from taking tissue for microscopic examination from all patients in whom the diagnosis of juvenile fibroma is perfectly obvious by clinical examination. Also, the taking of tissue for biopsy from one of these lesions should never be attempted as an office procedure; rather, it should be done with the patient under the influence of intratracheal anesthesia in the hospital, where facilities for controlling a severe hemorrhage are available.

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Clinical Evaluation of Diatomic Iodine Therapy in Infections of the Throat

LOUIS E. SILCOX, M.D., Philadelphia

Since the introduction of antibiotic troches for the treatment of acute and chronic infections of the throat and as a dental prophylaxis after extraction of infected teeth there have been reports of sensitivity of allergic reactions to the local use of these preparations. Penicillin has been the commonest offender, and it has been observed that over 20% of patients treated with penicillin troches have had local tissue reaction to the antibiotic. The clinical evidence of this sensitivity is the redness and swelling of circumvallate papillae at the base of the tongue and a diffuse redness and swelling of the remainder of the tongue, buccal mucous membrane, and soft palate. Troches containing chlortetracycline (Aureomycin) have caused similar reactions. The widespread use of these antibiotics as local medicaments, particularly in allergic persons, may produce a sensitivity which will prevent future parenteral use of that antibiotic should the person need it for a more serious systemic infection.

Prior to the advent of antibiotic and sulfonamide treatment of throat infections many types of antiseptic gargles were used with varying degrees of success. Bacterial counts on samples of saliva before and after use of these mouth antiseptics show a definite reduction in the numbers of oral bacteria, including the alpha streptococci, lactobacilli, and fusiform bacteria.[1]

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Although the excellent germicidal properties of aqueous iodine solutions have been known for years,[2] a clinical study of the effects of such a solution as a gargle appears to have been overlooked. Further, recent studies [3] have shown that the usual aqueous iodine solution, such as strong iodine (Lugol's) solution U. S. P., contains free iodine in two forms, triiodide and diatomic iodine, and that the antimicrobial activity of triiodide is small or negligible compared with that of diatomic iodine. This study was initiated to determine the effect of a near-saturated solution of diatomic iodine on acute, subacute, and chronic infections of the throat.

The aqueous solubility of crystalline iodine which gives rise to a diatomic iodine solution is only 0.03% at room temperature. The medical profession has been using metallic iodides, as for example potassium iodide, to increase the solubility of iodine. The additional solubility of iodine is due entirely to the formation of triiodides according to the equation

$$I_2 + I^- = I^-_3.$$

Thus, a 5% dilution of strong iodine solution cannot have more than 0.03% of its free iodine in the diatomic state.

The pH of a saturated diatomic iodine solution is 3. In the present investigation a convenient method was employed to obtain diatomic iodine solutions of known dosage at pH 6. Heliogen * tablets were used. This

* Supplied through the courtesy of Heliogen Products, Inc., Long Island City 3, N. Y.

preparation is an effervescent tablet which contains chloramine-T and potassium iodide in such a ratio that an instantaneous solution of diatomic iodine is formed free of triiodides. The tablet also contains buffer (sodium biphosphate) and flavor (dextrose) to render the solution palatable. One tablet produces 22 mg. of diatomic iodine regardless of the quantity of water used. The germicidal activity of a solution resulting from one tablet being dissolved in several ounces of water has been described.[4] Results indicate that pathogenic bacteria in vitro are killed on contact within 10 seconds, some of the pathogens being hemolytic Staphylococcus aureus, hemolytic Streptococcus, Corynebacterium diphtheriae, Pneumococcus Type III, and Klebsiella pneumoniae. Bacterial counts of saliva before and immediately after rinsing the mouth for one minute with 20 cc. of solution formed by dissolving one Heliogen tablet in 3 oz. of water showed a reduction of from 25,000,000 organisms to fewer than 1000 per milliliter of saliva.

Patients were given Heliogen tablets and instructed to dissolve one tablet in one-half glass of water and gargle for three minutes every three hours. A new tablet was used for each gargle. Patients were examined at regular intervals and repeat cultures taken at the time of those examinations. These cultures were taken from the infected areas and promptly planted on blood-agar plates. The condition of the patient's throat at these examinations was recorded and the patient's subjective appraisal of his condition was also tabulated and any side-effects noted. Clinical cases of such severity were selected that controls, in my opinion, were not essential in ascertaining the positive effects of medication.

The accompanying Table is a record of these examinations.

COMMENT AND SUMMARY

Forty-five patients with acute and chronic infections of the throat were treated with a near-saturated solution of diatomic iodine free of triiodides. This solution was conveniently prepared by dissolving a Heliogen tablet in half glass of water. Patients used this solution as a gargle for three minutes every three hours. Clinical and bacteriologic examinations were made before and after treatment in each case. There were 13 patients with excellent results, 25 with good results, and 7 patients were not improved.

The rapidity with which patients obtained symptomatic relief from sore throat and dysphagia after using Heliogen tablets dissolved in water as a gargle was remarkable. Inasmuch as there are no anesthetic or analgesic properties attributable to Heliogen, it is logical to assume that these subjective responses are dependent upon its bactericidal action. The clinical observations of reduction in swelling in the pharynx, disappearance of exudate and redness from the tissue within a short time are indicative of the fact that in spite of its bactericidal action it is not irritating or harmful to pharyngeal tissue when used at the concentration and interval as noted above. The observed nontoxic and nonirritating properties of Heliogen solution are in keeping with the work of others [5] in the treatment of chronically infected wounds. Ryan and associates found that irrigation of wounds (for a period of almost 200 continuous days) with Heliogen solution containing 0.03% diatomic iodine gave no indication of being toxic or irritating.

The bacteriologic studies indicated that the pathogenic florae of the infected tissues of the throat are generally susceptible to the concentration of diatomic iodine used in this study. Occasional resistant strains and patients with deeply seated infection which could not be reached with a gargle did not show the rapid recovery characteristic of the majority of the patients observed in this series. Side-effects, such as dryness of the throat, were minimal. There were no allergic reactions to this drug.

It appears that a diatomic iodine solution as formed by Heliogen has a definite place in the pharmaceutical armamentarium of the physician, and in my experience is superior to any gargle that I have used for acute and chronic infections of the throat.

Data on Patients Receiving Diatomic Iodine for Throat Infections

Patient	Diagnosis	Duration of Infection, Days	Pretreatment Culture	Post-Treatment Culture	Side-Effects	Results
N. M.	Acute pharyngitis	2	Pneumococci; alpha-hemolytic streptococci	No growth	None	Pharyngitis subjectively and objectively; well in 3 days
J. C. Sr.	Acute pharyngitis	3	Alpha-hemolytic streptococci; hemolytic S. aureus; pneumococci	Alpha-hemolytic streptococci	None	Swelling and redness of soft palate and pharynx gone in 4 days
E. N. M.	Acute pharyngitis	5	Beta-hemolytic streptococci; hemolytic S. albus	Same	None	Sore throat cleared up in 1 wk.
J. S.	Follicular pharyngitis	2	Alpha-hemolytic Streptococcus; hemolytic S. albus; pneumococci	Pneumococci (one colony)	None	Excellent; exudate gone in 3 days
E. H.	Acute pharyngitis	7	Alpha-hemolytic Streptococcus; pneumococci	Pneumococci (few colonies)	None	Very good; redness and soreness gone in 48 hr.
J. S.	Acute pharyngitis and tonsillitis	3	Alpha-hemolytic streptococci; beta-hemolytic streptococci	No growth	None	Temp. normal 48 hr.; tonsils and pharynx appeared normal in 6 days
M. M.	Subacute pharyngitis	7	Beta-hemolytic streptococci; pneumococci; hemolytic S. albus	Pneumococci (1 colony)	None	Subjectively and objectively better in 3 days
S. S.	Acute pharyngitis	2	Pneumococci; alpha-hemolytic Streptococcus	Beta-hemolytic streptococci	None	Excellent; acute condition subsided in 48 hr.
J. W.	Acute tonsillitis	3	Alpha-hemolytic Streptococcus	Nonhemolytic S. albus	None	Excellent; soreness and exudate gone in 3 days
M. Y.	Acute pharyngitis	..	Pneumococci; alpha-hemolytic streptococci	No growth	None	Very good; redness of pharynx and dysphagia gone in 3 days
A. S.	Acute nasopharyngitis	1	Alpha-hemolytic streptococci; beta-hemolytic streptococci	Alpha-hemolytic streptococci	None	Very good; patient symptom-free in 3 days
M. V.	Acute pharyngitis	5	Pneumococci; beta-hemolytic streptococci	Pneumococci	None	Very good; slight soreness after 3 days; asymptomatic in 5 days
M. G.	Acute pharyngitis	2	Hemolytic S. aureus; beta-hemolytic Streptococcus	Beta-hemolytic Streptococcus	None	Good; dysphagia and fever gone in 48 hr.; slight soreness for 3 days
A. D.	Acute tonsilitis	1	Beta-hemolytic streptococci	Same	None	Fever and sore throat continued after 4 days and patient treated with parenteral penicillin
E. S.	Chronic hyperplastic pharyngitis	60	Hemolytic S. aureus; pneumococci	Pneumococci	None	Some improvement after 1 wk. subjectively but no change in appearance of throat
E. S.	Acute pharyngitis	5	Alpha-hemolytic streptococci; beta-hemolytic streptococci	No growth	None	Excellent; symptoms disappeared in 48 hr.
H. D. F.	Acute pharyngitis	1	Pneumococci	Pneumococci (occasional colony)	Made her throat "dry"	Very good; dysphagia and redness of pharynx gone in 3 days
H. T.	Acute follicular tonsillitis	2	Beta-hemolytic streptococci	No growth	None	Very good; temp. subsided in 48 hr.; tonsils appeared normal in 1 wk.
E. DeS.	Chronic pharyngitis (from postnasal drainage)	365	Hemolytic S. aureus; pneumococci	Pneumococci	None	Improved; symptoms of sore throat and postnasal drainage persisted
M. M.	Acute pharyngitis	2	Alpha-hemolytic streptococci; hemolytic S. aureus	No growth	None	Excellent
V. Z.	Acute follicular pharyngitis	3	Beta-hemolytic streptococci; alpha-hemolytic streptococci	Beta-hemolytic streptococci	None	Very good; exudate disappeared in 48 hr.; patient was symptom-free in 4 days
R. W. Jr.	Subacute pharyngitis	7	Pneumococci; hemolytic S. aureus	Pneumococci	Dryness of throat	Very good

J. G.	Chronic pharyngitis	42	Hemolytic S. aureus; pneumococci; diphtheroids	Pneumococci (occasional colony)	None	Good; symptomatically improved; culture showed only a few pneumococci remaining
E. H.	Chronic hyperplastic pharyngitis	60	Pneumococci; viridans streptococci	Pneumococci	None	Very good
M. L.	Subacute pharyngitis	30	Viridans streptococci; hemolytic S. aureus	No growth	None	Clinically improved but still complained of sore throat every morning
J. J. W.	Aphthous ulcers of mouth and throat	3	None taken	.....	None	Marked improvement in 48 hr.
L. A.	Vincent's infection of gums and lymphoid tissue in throat	..	Spirillae; fusiform bacilli	After 3 days' treatment Vincent's organisms still present	None	Mouth and throat lesions improved in 3 days
H. D.	Infected ulcer of pharynx following radium treatment of a carcinoma	180	Hemolytic S. aureus; viridans streptococci	Viridans streptococci	None	Improved appearance of ulcer and reduced the pain by decreasing infection
M. T.	Acute pharyngitis	3	Beta-hemolytic streptococci	No growth	None	Very good; marked improvement in 48 hr.
H. A.	Chronic hyperplastic pharyngitis	90	Beta-hemolytic streptococci; hemolytic S. aureus; pneumococci	Pneumococcus	None	Subjectively his throat felt better but did not change in appearance in 1 wk.
I. A.	Peritonsillar abscess	2	None taken	.....	None	No improvement after 48 hr.; then treated with incision and drainage
G. T.	Acute pharyngitis	5	Beta-hemolytic streptococci; pneumococci	Beta-hemolytic streptococci; an occasional colony of pneumococci	None	Very good; patient asymptomatic in 3 days
H. S.	Acute infection of tonsil tags	2	Beta-hemolytic streptococci; viridans streptococci	No growth	None	Excellent; temp. subsided in 48 hr.; patient symptom-free in 4 days
R. B.	Acute pharyngitis	1	Pneumococci; hemolytic S. aureus	Pneumococcus	None	Very good; soreness relieved in 48 hr.
N. B.	Acute pharyngitis	5	Hemolytic S. aureus; pneumococci	Occasional colony of pneumococci	None	Very good; dysphagia and redness of throat disappeared in 3 days
B. A.	Chronic hyperplastic pharyngitis	180	Pneumococci; viridans streptococci	Viridans streptococci	None	Pharyngitis improved objectively and subjectively in 1 wk.
J. P.	Acute pharyngitis	5	No growth obtained	No growth	None	Improved soreness and redness in throat; infection may have been of viral origin
T. O. B.	Infected tonsils	90	Viridans streptococci; hemolytic S. aureus	Hemolytic S. aureus	None	Good; pus still expressed from left tonsil but less inflammation and soreness
S. P.	Chronic pharyngitis	60	Hemolytic S. aureus	Nonhemolytic S. aureus	None	Moderate improvement; pharynx still inflamed after 10 days' treatment
E. S.	Acute pharyngitis	1	None taken	None	None	Improvement in 24 hr.; asymptomatic in 48 hr.
S. S.	Acute tonsillitis	2	Beta-hemolytic streptococci; alpha-hemolytic streptococci	No growth	None	Sore throat and fever absent in 3 days; exudate gone in 5 days
M. T.	Hyperplastic pharyngitis	42	Viridans streptococci; Pneumococcus	Pneumococci (occasional colony)	None	Very good; appearance of pharynx improved in 1 wk. and dysphagia absent
G. G.	Acute tonsillitis	2	Alpha-hemolytic streptococci	No growth	None	Excellent; acute soreness disappeared in 2 days; redness and swelling gone in 5 days
J. M.	Chronic pharyngitis (postnasal drainage)	90	Hemolytic S. aureus; pneumococci	Same	None	Poor; postnasal drainage reinfected pharynx
A. N.	Follicular tonsillitis	3	H. influenzae	No growth	None	Tonsillar areas improved in appearance after 5 days but soreness remained for 1 wk.

Prof. B. Carroll, of Rutgers University, made available a preprint of his bacteriological paper.

255 S. 17th St. (3).

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News and Comment

ANNOUNCEMENTS

Second Graduate Course in Plastic Surgery of the Head and Neck.—The American Otorhinologic Society for Plastic Surgery is giving the intensive course in Plastic Surgery of the Head and Neck, which will be held at the Morrison Hotel, at Clark and Madison Streets in Chicago, from Oct. 7 to 9, inclusive, 1955. A more detailed announcement of this course was published in the August issue, page 217.

SOCIETY NEWS

Central Illinois Society of Ophthalmology and Otolaryngology.—The 25th annual meeting of the Central Illinois Society of Ophthalmology and Otolaryngology will be held in Bloomington, Ill., on Oct. 6, 7, and 8, 1955, immediately preceding the meeting of the American Academy, in Chicago.

For information or reservations, please write Clarence A. Fleischli, M.D., 520 E. Allen St., Springfield, Ill.

Submaxillary Duct Calculi

A Simple Procedure for Their Removal

SIDNEY SPECTOR, M.D., Brooklyn

Calculi in the submaxillary duct do not commonly occur in the average otolaryngological practice, but when they do, the problem of convenient and proper management arises. We are very much indebted to Beck,[1] who, 20 years ago, called attention to this problem and suggested an excellent method for the removal of submaxillary calculi via the intraoral route. Moderate-sized calculi that are present within 1 to 4 cm. of the orifice in the floor of the mouth and very large calculi regardless of their distance from the duct orifice are readily palpable, and their removal is simply effected by fixing or immobilizing the stone and cutting down on it through the overlying tissue. However, when the calculus is small and is situated in the posterior portion of Wharton's duct where it is not palpable, a different approach is necessary.

The tissues in the floor of the mouth are very soft and easily displaced, so that if a definite plan of operation is not followed the anatomy becomes distorted, the duct is lost sight of, and the procedure becomes messy, frustrating, and frequently unsuccessful. It is the purpose of this paper to present a simple technique for the removal of calculi in the submaxillary duct via the intraoral route. Before outlining the suggested technique, it would be useful to review some of the principal features of calculi in the salivary ducts with respect to etiology, symptoms, diagnosis, and complications.

Submitted for publication May 2, 1955.

From Division of Otolaryngology, Department of Surgery, State University of New York College of Medicine at New York City, and Department of Otolaryngology, Long Island College Hospital.

There are several theories as to the cause of calculus formation in the salivary ducts. Some writers believe that inflammation in the salivary gland itself is the cause of stone formation. However, such inflammation is frequent in the parotid gland, but the parotid-duct calculi are comparatively rare. Ivy and Curtis [2] mention the work of Soderlund and Naeslund, of Sweden, who examined 41 and 50 cases, respectively, of salivary calculi and found each stone to contain Actinomyces. They believe that the ray fungus enters the duct and establishes colonies. The organisms are said to decompose the proteins of the saliva, causing a change in the hydrogen-ion concentration with the precipitation of calcium salts, which are deposited around the colonies of organisms to form the calculus. However, Ivy and Curtis [3] have been unable to confirm this in a series of 115 cases. Some writers state that a foreign body may gain entrance into the salivary duct and serve as the nidus for calculus formation, but this must be very rare. Undoubtedly, poor oral hygiene and insufficient fluid intake are factors in the causation of this condition.

The symptoms are classical and almost pathognomonic. One notices a feeling of fullness, swelling, and pain in the submandibular area, usually associated with the intake of food or drink. The spicier the food, the greater the discomfort and swelling. After the first episode, the swelling usually subsides within several hours and the discomfort disappears, only to recur again. These recurrences associated with food intake should lead to the strong suspicion of an obstruction in the submaxillary duct. Another important symptom is a sensation of soreness in the floor of the mouth, which is caused by inflammation of the tissues surrounding Wharton's duct. The inflammatory reaction may be very mild or may result in a cellulitis of the tissues on the

involved side. The patient also notices the periodic appearance of a foul material in the mouth. This is due to the purulent salivary secretion that periodically issues from the opening of the duct. The suppuration arises within the submaxillary gland, collecting tubules and ducts as a result of stasis of the secretions. The gland tissue, itself, is fairly resistant to destruction but in long-standing cases becomes fibrosed, with little epithelial tissue remaining.

The obstruction may be due to inspissated debris or an actual calculus. Since most calculi are radiopaque, x-rays should be taken and the stone will be demonstrated by the presence of an opacity in the course of the submaxillary duct. The best views are the lateral oblique and the occlusal. In the lateral oblique position, the uninvolved side of the jaw is tilted upward out of the path of the x-rays and the picture obtained usually shows a calculus superimposed on the body of the mandible. In most cases the density of the stone makes it readily visible. However, when the density is less intense, the calculus may be missed as a result of superimposition on the body of the mandible. In that case, a straight lateral may project the calculus below the body of the mandible and thereby make it more readily seen. The lateral oblique view is also useful in that it localizes the approximate anteroposterior position of the calculus within the duct. In the occlusal view, a film is placed into the patient's mouth as far back as possible and the patient instructed to bite down on it in order to hold it in position. The x-rays are directed from below the chin. This view will demonstrate calculi in the anterior 4 to 5 cm. of the duct without the superimposition of other bony structures but may fail to demonstrate those situated more posteriorly. The x-ray studies will not only determine the presence of a stone but will also reveal its location in the duct.

Wharton's duct is approximately 2½ in. long, and calculi may be found anywhere along its course. As was mentioned previously, moderate-sized calculi that are situated within 4 cm. of the orifice are easily removed because they are usually palpable. However, small calculi situated more posteriorly are not palpable, and the duct must be explored from its termination at the orifice to its origin at the submaxillary gland if a successful removal is to be effected.

It would be useful, now, to review the surgical anatomy [4] of the submaxillary duct. It arises from the deep surface of the submaxillary gland and runs forward deep to the mylohyoid muscle and medial to the deep process of the gland. It passes forward medial to the sublingual gland within the floor of the mouth, lateral to the hyoglossus, and opens into the mouth at the side of the frenulum linguae on the summit of a papilla called the caruncula sublingualis. In its course in the floor of the mouth the duct is crossed by the lingual nerve opposite the second molar tooth. The nerve is, at first, lateral to the duct, then crosses inferior to it, and passes medially to the tongue. It is at this point of crossing that the lingual nerve may be injured in operations on the duct. Damage to the lingual nerve causes anesthesia of the floor of the mouth and one-half of the tongue and results in an inability to orient the position of the tongue.

The following technique has been found to be very effective in dealing with calculi regardless of their size or location in the duct. The anesthesia of choice is a lingual nerve block via the intraoral route, using 1.5% butethamine formate (Monocaine) and 1 : 50,000 epinephrine solution. The injection is made immediately lateral to the pterygomandibular raphe into the lingual nerve as it passes close to the mandibular foramen on the medial surface of the ramus of the mandible. This is superior to local infiltration of the floor of the mouth because it eliminates distortion of the anatomy along the course of the duct. The first step is to pass a rigid probe into the orifice and through the duct as far as it will go and to have an assistant hold the probe in that position. If the stone is very large, it will impede the progress of the probe and, of course, further probing is then unnecessary. When the stone is small, the probe usually passes over it and probing is continued until the gland is reached. Using the probe as a lever, and as-

sisted by upward pressure on the submaxillary area externally, the duct with its indwelling probe and the tissues in the floor of the mouth superficial to the duct are elevated and kept so by the assistant. It will be noticed that the tongue gets in the way. It is difficult to retract the tongue efficiently with a tongue depressor. The best method is to pass a suture through the lateral edge of the tongue, and by means of a clamp on the suture ends it is easily rolled over out of the operative field (Fig. 1). Then, one blade of a thin, sharp-pointed scissors is inserted into the duct orifice along the superior surface of the probe and the duct is slit open for a distance of ap-

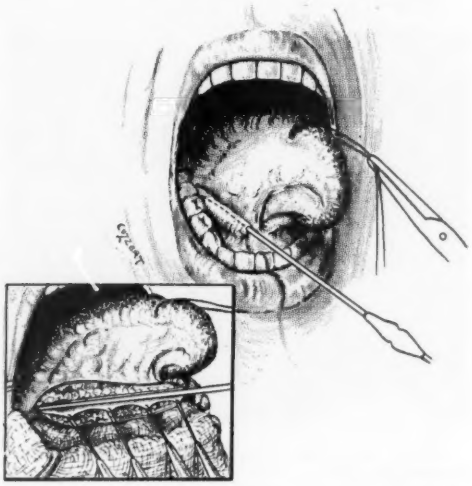

Fig. 1.—Suture passed through lateral edge of the tongue, and by a clamp on the suture ends the tongue is rolled away from operative field.

proximately 1 cm. A 4-0 black nonabsorbable surgical (silk) suture is passed through the lateral edge of the cut ductal mucosa and the ends of the suture are grasped with a mosquito clamp. The clamp is then permitted to hang over the side of the face and its weight, alone, will provide ample retraction so that the slit portion of the duct is clearly exposed. One blade of the scissors is again inserted into the duct on the superior aspect of the indwelling probe and another 1 cm. of duct is slit open. Another 0000 nonabsorbable surgical suture is placed in the same manner as previously described. It will be noticed that the probe within the duct is passing deeper into the floor of the mouth as the duct is exposed. This procedure of incising or slitting the superior wall of the duct is repeated in stages until the entire duct from the caruncula sublingualis to its origin at the gland is exposed and the calculus visualized. As that portion of the duct lying opposite the second molar tooth is approached (the area where the lingual nerve is closely related to the duct), it is necessary to be certain that the superomedial portion of the duct wall is incised because the lingual nerve is related to it laterally, medially, and inferiorly.

Bleeding throughout the procedure is slight and easily controlled with pressure despite the absence of local infiltration of epinephrine. The operative field is easily kept clean by the use of a Frazier suction tip. After the calculus has been extracted, the traction sutures are removed and the tongue is permitted to fall into its proper midline position. The operative wound is not sutured because the incised duct walls fall into good approximation.

Postoperatively, warm saline mouth irrigations and antibiotics are given. Discomfort is slight, and after a day or two of a soft diet the patient may return to his usual regimen.

It must be remembered that in all cases of salivary calculi there is a degree of inflammation of the corresponding salivary gland. The amount of adenitis present depends on how long the obstruction of the duct has been present. If there is a long history of recurring suppurations within the submaxillary gland with a stone in the duct, New and Harper [5] recommend excision of the gland in addition to removal of the calculus. They reported a series of 30 cases in which a stone was removed from the duct but recurrent submaxillary adenitis persisted in 4 (13%). In 13 cases in which a stone was removed from the gland, there were 3 (23%) that had a recurrence of symptoms. In those cases in which the submaxillary gland was totally removed, there was no return of symptoms.

The above-described procedure has been done in three cases, brief descriptions of which follow:

Fig. 2 (Case 1).—Occlusal view of the calculus.

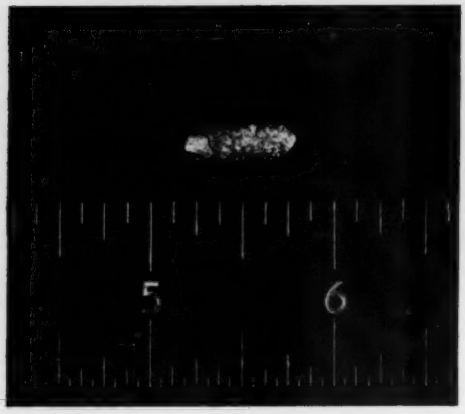

Fig. 3 (Case 1).—The removed calculus.

Fig. 4 (Case 2).—Lateral oblique view of the calculus.

REPORT OF CASES

CASE 1.—S. G., a 41-year-old white woman, was seen in February, 1953, with a complaint of swelling in the left submandibular region brought on by food intake and accompanied by soreness of the floor of the mouth on the left side of three weeks' duration. There had been a similar acute episode two years before that lasted for several weeks, and until consultation there was occasional fullness in the left submandibular area during and after meals.

Examination revealed a tender, walnut-sized, firm left submaxillary gland. Intraoral examination revealed moderate redness and swelling of the floor of the mouth on the left with a slightly patulous submaxillary duct orifice, from which purulent secretion was easily expressed. A hard mass was palpable in the floor of the mouth approximately 2 to 3 cm. from the duct orifice. Occlusal x-ray views demonstrated this mass to be a calculus (Fig. 2).

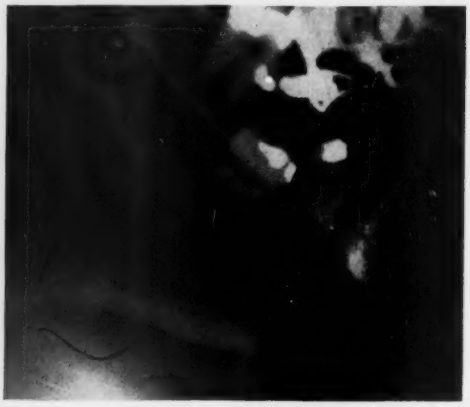

Fig. 5 (Case 3).—Calculus in the posterior portion of the duct.

The stone was removed by the above-described technique, and the patient has been well since. Figure 3 shows the removed calculus. It will be noted that it is oval or tubular in shape. Calculi that are found well within the duct are usually shaped so because of the pressure of the duct walls. Follow-up examinations for several months have shown a normal functioning gland and duct.

CASE 2.—L. R., a 36-year-old Puerto Rican man, was seen in December, 1954, complaining of pain and swelling in the right submaxillary region of five days' duration. There was marked induration and edema of the floor of the mouth on the right side, and the submaxillary gland was enlarged and tender. A hard mass was palpable approximately 5 cm. from the duct orifice, and lateral oblique x-rays revealed the mass to be a calculus (Fig. 4).

The patient was treated with antibiotics and fluids to reduce the inflammation in the floor of the mouth, and 10 days later the stone was removed by the described technique. Postoperatively the patient was comfortable, and healing of the duct was complete within 10 days. There was no stenosis of the duct, and no further episode of gland enlargement or tenderness has occurred to date.

CASE 3.—E. L., a 29-year-old white man, was seen in December, 1954, with a complaint of one week's duration of pain and swelling of the right submaxillary area, made worse by eating. There had been a similar episode of milder severity one year ago. Examination revealed a tender, walnut-sized submaxillary gland but no induration in the floor of the mouth. Pus was expressed from the duct orifice. X-rays showed the presence of a calculus in the posterior portion of the duct, but the calculus was not definitely palpable (Fig. 5). The stone was removed by the above-described technique in February, 1954, and is shown in Figure 6. It was found to be lying within the duct at its origin from the gland, and this accounts for the irregular square shape of the calculus. Several small pieces were broken off during the removal.

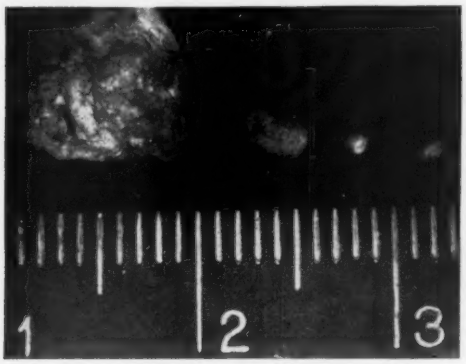

Fig. 6 (Case 3).—The removed calculus.

Postoperatively the patient was comfortable, and healing was complete within 10 days. One month later, the submaxillary gland had returned to normal size and was not tender. There is an unobstructed flow of clear salivary secretion from the duct orifice.

SUMMARY

The principal features of submaxillary calculi with regard to etiology, diagnosis, treatment, and complications are discussed. A simple procedure for the intraoral removal of submaxillary duct stones is presented.

Three cases are presented in which the described procedure has been very satisfactory.

225 Eastern Parkway.

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Audiology Section

JOSEPH SATALOFF, ASSOCIATE EDITOR

Auditory Difference Limen of Intensity in Normal Hearing Subjects

JUERGEN TONNDORF, M.D.
F. A. BROGAN, B.A.
and
1st LIEUT. DAVID D. WASHBURN (MSC), U.S.A.F.

INTRODUCTION

The ability of the human ear to recognize changes in sound intensity is not a system of infinitesimal increments but is limited rather to discrete steps. The just-noticeable difference of intensity is generally referred to as the difference limen (DL) of intensity. Employing a method of "minimal changes" and using accurate electronic equipment, Knudsen [8] and later Riesz [11] first systematically investigated the DL. A slow sinusoidal fluctuation of intensity was produced. The voltage amplitude at which fluctuation was just noticed by the listener was related to that of the minimum of sinusoidal event in terms of absolute voltage; the DL was thus expressed as $\Delta E/E$. By this method the DL was measured for various stimulus parameters. In general, the smallest values were found for a repetition rate of fluctuation between 3 and 4 cps. Being large for low sensation levels (SL) of the minimum voltage (E), the DL decreased rather rapidly as the sensation level was increased, until a plateau was reached at an SL of approximately 40 db. Changes in carrier frequency modified this general pattern only slightly, and not in principle.

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From the School of Aviation Medicine, Randolph Field, Texas.

Dr. Tonndorf is now with the State University of Iowa.

A seemingly related problem—the relation between loudness and intensity of a given tone—was studied by Fletcher and Munson [3] and later by Stevens.[16] In the latter investigation a method of "equal-appearing intervals" was employed whereby intensity was altered in steps until loudness was judged to be halved. By a sufficient number of repetitions of this loudness fractionation, the relation of loudness *vs.* intensity was established for various frequencies over a wide range of intensity. The reference point was 40 db. SL, equal to one sone, the unit of loudness proposed by the latter investigator. More recently, Garner [6] presented a method designed to minimize the major obstacle—individual variation. If his findings are borne out, loudness fractionation may become a more reliable method than it has been thus far.

Neither type of measurement gained importance in clinical audiometry until the phenomenon of recruitment was first detected by Fowler.[4] That is, he was first to realize that there is a characteristic change in the loudness *vs.* intensity relation in cases of hearing impairment of cochlear origin. Although starting at an elevated threshold, loudness sensation increases in larger-than-normal steps with intensity, thereby gradually approaching levels found in normal hearing persons. As interest lay only in the related change with respect to the normal, recruitment was first measured by the so-called "loudness-balance technique," which is applicable in cases of unilateral deafness. For various sensation levels of a given tone in the normal ear, the subject was asked to determine which intensities sounded the same to both of his ears. This may be called a method

of "adjustment." In cases of bilateral deafness it has become a custom to compare, by alternate presentation to that ear, a frequency for which hearing is impaired, to another for which hearing is normal.

Measurements of adjustment are generally not considered to be as reliable as those of minimal change. For this reason, and obviously based on Fechner's assumption that loudness and DL are closely related, Lüscher and Zwislocki [9] introduced the aforementioned method of measuring DL for determination of recruitment.

Naunton and Denes [10] objected to the use of regular modulation of intensity because such a method invariably produces side bands, which are the summation of and difference between the carrier and modulation frequencies. Consequently, these authors argued that the clue for the listener may consist of a combined intensity and frequency alteration. Accordingly, they introduced a testing technique of their own which is essentially a method of "paired comparison." When using this method, two stimuli, equal in frequency but differing in intensity, are presented in succession with a brief silent interval between them. The subject is asked to judge whether or not an intensity difference existed between the two signals. It is the consensus that the outcome of such a method depends largely on the listener's ability to memorize absolute values of intensity.

For the present investigation a method of regular modulation similar to Riesz' * original technique was chosen by reason of its easier application. A few words of explanation may be in order because of the aforementioned critique concerning the origination of side bands. Shower and Biddulph,[13] when faced with a similar problem in their study of DL of frequency, found by calculation the total intensity of those side bands to be —6.2 db. from that of the fundamental. Therefore, they concluded that, in comparison with other sources of error, the effect of side bands was small and could be neglected.

* References 11 and 12.

A similar deduction can be made for the case at hand. By calculation † it can be shown that the intensity of the side bands is considerably below that of the carrier signal. For instance, for a sensation level of 10 db., for which Riesz found the difference limen (expressed as the ratio $\Delta E/E$) to be 0.4, the intensity of the side bands is found to be —11.6 db., i. e., below the subject's threshold of perception; for a sensation level of 40 db., for which, according to Riesz, the ratio of the difference limen is 0.1, the value of intensity of the side bands is 16 db., i. e., still relatively small. Therefore, it can be concluded that the effect of side bands upon the outcome of these tests does not warrant giving up a method which is so easy to apply to untrained listeners.

The instrument used in this study was constructed by one of us and is described in a separate paper.[1] The present paper is concerned with the validation of the test method on normal hearing subjects—a matter which has received little attention in the literature. In addition, an attempt was made to correlate results from loudness balance with those from DL measurements.

INSTRUMENTATION AND TESTING PROCEDURES

The block diagram of the instrument is shown in Figure 1. By closing the interrupter switch (INT SW), the carrier signal is modulated in the modulated amplifier by the low-frequency oscillator, which can deliver sinusoidal, triangular, or square-wave signals. The distortion resulting from this type of modulation is removed in the band-pass filter, and the signal, after passing through calibrating and output attenuators, is finally presented to the listener's ear. The degree of modulation at the output is independent of the setting of the output attenuator (i. e., from the level of presentation). Instead, it is proportional to the ratio of carrier and

† For the full mathematical treatment the reader is referred to the technical report on this subject (USAF School of Aviation Medicine, Randolph Field, Texas) which is currently in press under the same title.

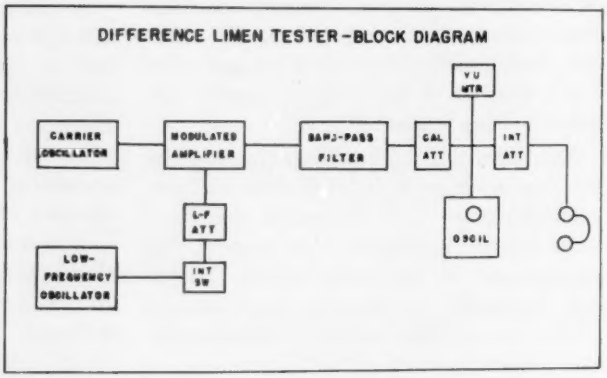
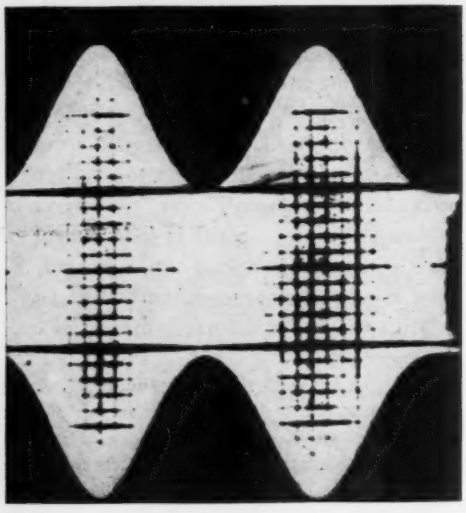


Fig. 1.—Block diagram of instrumental set-up.

low-frequency voltages, which is controlled by the L-F attenuator (1 db. steps). A 50% modulation was chosen for the sake of convenient calibration. (See Figure 2. The picture was taken from the oscilloscope within the circuit.) During calibration, the L-F attenuator is set at —6 db. so that during actual operation its readings are always referred to 100% modulation. The intensity of the unmodulated carrier signal produced at the earphone was calibrated by means of a standard microphone coupler built to specifications of the National Bureau of Standards. Prior to each test the calibration attenuator was adjusted to the appropriate reading of the VU meter.

Fig. 2.—Oscilloscope picture of 50% modulation.



In actual operation, first were selected, from the low-frequency oscillator, the repetition rate and the shape of the modulating signal; next the carrier oscillator was set to the desired test frequency and the filter switched to the appropriate band pass. Because of the filter limitations, 200, 400, 800, 1600, and 3200 cps were used as standard test frequencies. After calibration, the subject's threshold for the unmodulated carrier signal was determined in conventional audiometric fashion. During this period the interrupter switch was connected with the main output line instead of the position shown in Figure 1. After the threshold was determined, the first SL was selected (usually 10 db.) and testing of the DL started. Signals modulated to varying degrees were presented, separated from each other by means of the interrupter switch. This was continued until the just-detectable amount of modulation was found. By means of a signal light the subject indicated when modulation was detected.

The attenuator readings can be converted into any other expression of the DL, since they present decibel values of per cent modulation. A table has been prepared for this purpose. For convenience of comparison with other values, we, among others, prefer to use the ratio in decibels between the maximum and minimum of modulation, which are shown as peak and trough on one side of the modulated signal in Figure 2. In Figure 3 this expression of the DL, together with the necessary conversion formula, is plotted

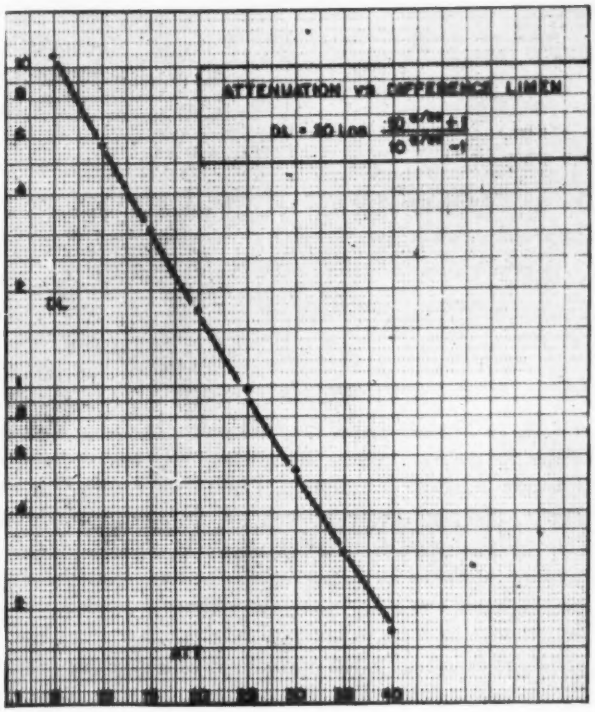


Fig. 3.—Conversion of readings from L-F attenuator (Fig. 1) into DL values in decibels; conversion formula included.

against the decibel settings of the L-F attenuator. As is obvious from the figure, there is one advantage in this expression—namely, the sensitivity of the test increases with decreasing values of the DL (i. e., when accuracy is most needed).

In its full magnitude, DL is thus presented as the width of swing around a predetermined sensation level instead of being presented as a simple increment (or decrement) from such a value, as was postulated in the classical concept. This is felt to be only a gradual, not an essential deviation from this concept, and in our experience it is outweighed by the ease of application of this test even to untrained subjects.

Further details of the construction, testing procedure, and conversion into other expressions of the DL used by other authors may be taken from the original paper on instrumentation.[1]

MODE OF TESTING

The effect of the mode of testing (i. e., whether smaller DL's were obtained when the test runs were conducted in a descending or in an ascending fashion) was assessed in the following manner: Seven semitrained subjects were tested, using a carrier signal of 800 cps, SL of 10 db., and modulation rate of 3 cps (sinusoidal wave pattern). Starting at a high degree, modulation was decreased in steps of 1 db. After the minimum value was passed, decrease of modulation was continued for at least two additional steps before the procedure was reversed. In this way the subject was given a minimum of clues with regard to the procedure. After completion of the test a total of 58 paired comparisons, approximately 8 per subject, could be made between subsequent threshold crossings in opposing test-run directions. In 35 of such paired comparisons smaller DL's were registered in the descending test-run direction (Class A Table 1), while in only 17 of the paired comparisons the reverse relation was found (Class B). In six cases, no difference between the two directions was observed (Class C). Quantitatively, the results were as follows: The difference between the average of all cases and that of Class A results

TABLE 1.—*Comparison Between Descending and Ascending Modes of Testing*

Group	Frequency of Occurrence	Mean Deviation from Total Average
A: descending mode of testing resulting in larger degrees of attenuation, i. e., smaller DL values	35	+1.220
B: ascending mode of testing resulting in larger degrees of attenuation, i. e., smaller DL values	17	—0.264
C: equal attenuation, i. e., equal DL in both test-run directions	6	+0
Total.....	58	+0.658

was + 1.220 db., while the difference between the over-all average and that of Class B results was only — 0.264 db. The distribution is, then, markedly skewed toward the Class A results. The figure of + 0.658 db. signifies the value, in the average of the total, for which the test runs in the descending direction gave larger attenuation values (smaller DL's) than that in the opposite direction.

This figure of + 0.658 db. should be compared with the variance of attenuator readings obtained from test runs in one direction only (e. g., those taken in the descending manner, of which a total of 60 measurements had been taken). For this, the average in-subject standard deviation obtained from all seven subjects was 0.566 db. Thus, the average difference in decibel attenuator readings between opposing test-run directions approximated one standard deviation of decibel attenuator readings taken from one test-run direction only.

TEST RESULTS

Young Air Force recruits were used for general evaluation, that is, whenever testing of larger groups of subjects was required. The average age of the subject was 19 years. Each was available for a period of four hours only and could not be recalled for rechecks if such were felt necessary. Therefore, each partial question had to be investigated on a separate group of subjects. Each subject was first given a conventional audiometric test to assess "normal hearing." Only those subjects were accepted for DL testing who had no more loss than 10 db. for the frequencies to be investigated and not more than 20 db. for any other frequency up to 4000 cps, inclusive.

First the degree of influence of repeated testing on test results was investigated. This was assessed on a group of 14 subjects who were tested monaurally at regular intervals four times during the course of half a day (i. e., approximately once every hour). The carrier frequency was 800 cps; four sensation levels (5, 10, 20, and 40 db.) were used; modulation frequency was 3 cps and the modulation pattern were sinusoidal. The results shown in Table 2 indicate that at all but the lowest sensation level (5 db.) the average attenuation value increased from the first to the last test, viz., the DL became smaller, the differences being highly significant. No significant change was observed at the lowest level (5 db.). This improvement of skill was similar for all subjects, since the standard deviations remained unchanged for all four sensation levels.

Next, an attempt was made to find which type of modulation was best suited to the purpose of the test. To this end, binaural tests were conducted on 29 subjects (58 ears). All three types of modulation patterns (sinusoidal, triangular, and square wave) were applied, although their actual sequences were randomized among subjects. Modulation rates were 1.5, 3, and 6 cps. The carrier signal was 800 cps and sensation levels were 5, 10, 20, and 40 db. In Figure 4 the average results are shown for the 5 db. SL. They were similar at the other SL's not shown here. Square-wave modulation was far superior in rendering smallest DL values, while the sine-wave pattern was only slightly better than the triangular one. There was no sig-

TABLE 2.—*Effect of Training by Repeated Testing**

	Sensation Levels, Db.			
	5	10	20	40
First test	14.9 ± 2.27	18.0 ± 1.66	21.2 ± 1.78	23.9 ± 1.88
Fourth test	15.3 ± 2.12	18.9 ± 1.75	22.5 ± 1.89	25.4 ± 1.86
T-values	1.81	5.75	7.12	7.85

* Four tests were given at one-hour intervals. Carrier signal, 800 cps; modulation frequency, 3 cps; modulation pattern, sinusoidal; N = 14. Figures represent averages and standard deviations.

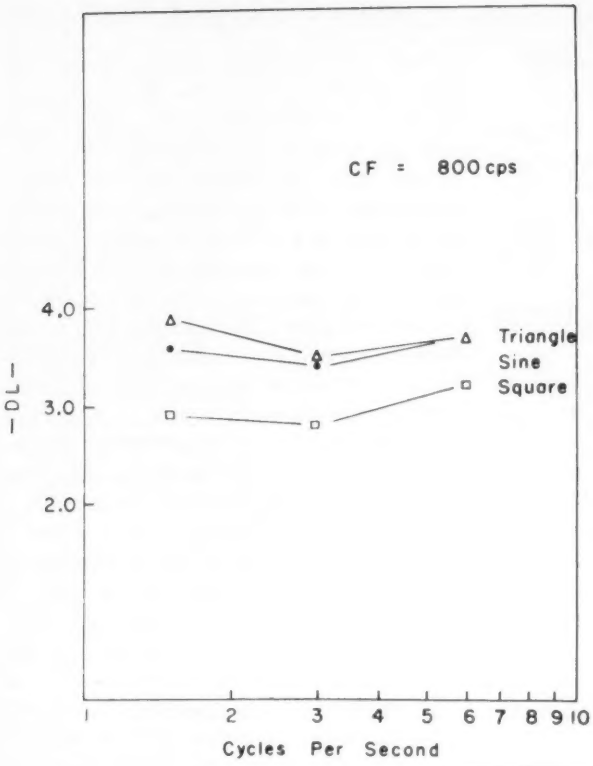


Fig. 4.—DL of intensity *vs.* rate of modulation; carrier frequency and wave form as indicated.

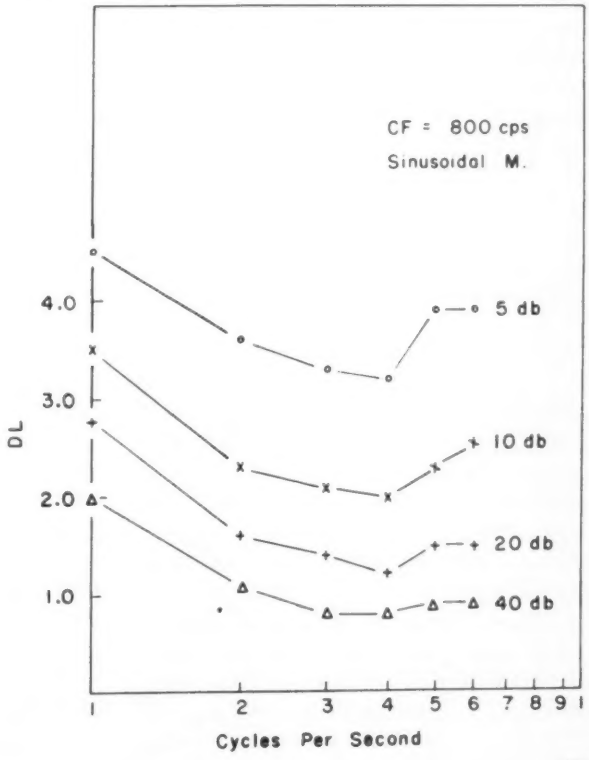


Fig. 5.—DL of intensity *vs.* rate of modulation with sensation level as parameter; carrier frequency and wave form as indicated.

TABLE 3.—*DL vs. Modulation Frequency**

Modulation Frequency, Cps	Sensation Level, Db. 5	10	20	40
1.....	4.5 ± 1.0	3.5 ± 1.1	2.8 ± .3	2.0 ± .6
2.....	3.6 ± .9	2.3 ± .5	1.6 ± .5	1.1 ± .3
3.....	3.3 ± .8	2.1 ± .5	1.4 ± .4	.87 ± .2
4.....	3.2 ± .8	2.0 ± .4	1.2 ± .2	.83 ± .2
5.....	3.9 ± 1.0	2.3 ± .5	1.5 ± .3	.96 ± .2
6.....	3.9 ± .8	2.5 ± .5	1.5 ± .3	.96 ± .3

* Carrier frequency, 800 cps; wave form, sinusoidal; N = 7. Figures represent averages and standard deviations.

nificant difference in variance between the three patterns. Since the sudden onset of the square-wave modulation might introduce audible transients, a carrier signal of 20,000 cps was chosen, which was inaudible to the listener. On introduction of modulation, sharp clicks were heard at double the rate of modulation (i. e., with each level change). This was the case even with the band-pass filter set to a width of less than one octave (e. g., 800 to 1200 cps). Even though the clicks were not outstanding, as long as audible carrier signals were present, it was felt that they might offer the listener clues for improvement of his test score. For this reason, square and triangular waves were abandoned and sinusoidal modulation was used exclusively thereafter.

Tests were conducted on 19 subjects (38 ears) in order to determine the variation of the DL with modulation frequency. Riesz, with his method, had found the DL to be smallest at 3.2 cps and had therefore recommended the use of 3-cycle modulation. Modulation rates of 1 through 6 cycles were investigated, using a carrier signal of 800 cps and sensation levels of 5, 10, 20, and 40 db. As seen in Figure 5, the variation with modulation frequency was similar for all sensation levels, reaching its smallest value at 4 cps, although the difference between 3 and 4 cps was rather small. In a similar manner, the between-subject variation reached a minimum at 4 cps, increasing somewhat toward both 1 and 6 cps (Table 3). For this reason, Riesz' [11] original value was kept and a modulation rate of 3 cps was used in all further tests.

Another group of 18 subjects (36 ears) gave information as to the variation of the DL for different carrier frequencies with the four sensation levels as parameters. The results are shown in Figure 6, from which it is apparent that the variation with frequency follows a similar trend for all SL's—namely, within the frequency range explored (200 to 3200 cps), the DL is seen to decrease with frequency, more at low than at high sensation

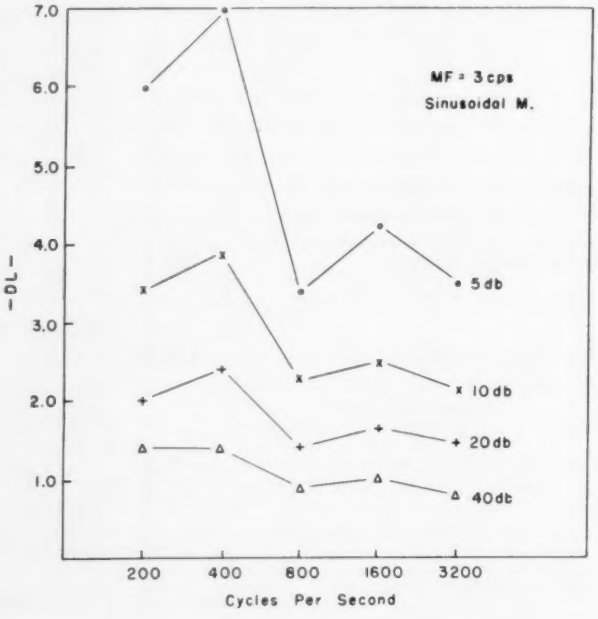


Fig. 6.—DL of intensity *vs.* carrier frequency with sensation level as parameter; modulation frequency and wave form as indicated.

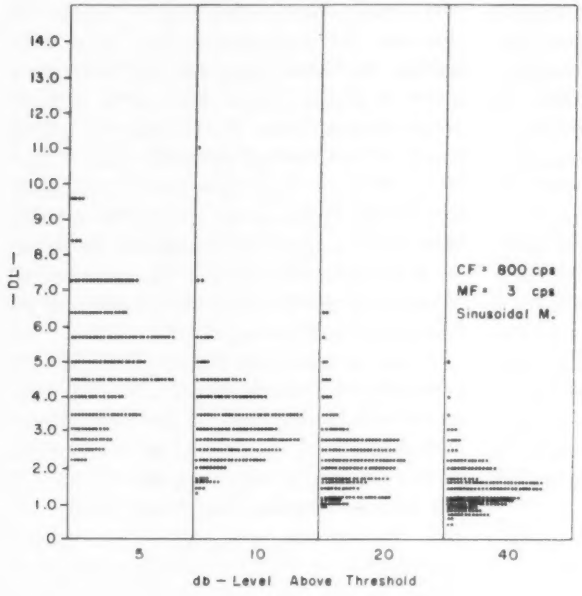


Fig. 7.—DL of intensity *vs.* sensation level (scatter diagram of 195 ears tested).

levels. However, statistically, only the low SL's (5 and 10 db.) of 200 and 400 cps were significantly different from the others.

Next, an attempt was made to establish limits of DL normalcy for future delineation of pathological subjects. As apparent from clinical studies,‡ it is only in the direction of small DL's at low SL's that pathological deviation from normalcy is encountered. This is thought to be indicative of the presence of recruitment. No pathological condition is known so far in which abnormally large DL's are seen. Besides the study by Naunton and Denes, who used a different technique, Jerger's study is the only one in which an attempt is made to establish limits of normalcy. In this particular part of the present investigation, 100 subjects (195 ears) were tested. The hearing acuity of these subjects was within normal limits in accordance with the above definition. Investigated were five carrier frequencies (200, 400, 800, 1600, and 3200 cps) and four sensation levels per carrier frequency (5, 10, 20, and 40 db.). Given in Figure 7 in the form of a scatter diagram are the results for 800 cps which are representative of this entire group. It is immediately apparent from this figure that the distribution at each sensation level is markedly skewed. This situation does not lend itself very well to expression by arithmetic means and standard deviations. For this reason percentiles were chosen. In Figure 8 for the same carrier frequency (800 cps) the results of Figure 7 are replotted, giving modes and limitations of the 90th centile, which, for the case of normal distribution, is known to be equivalent to 2.56 standard deviations.

In the study by Jerger,[7] whose testing technique most closely resembled ours, the averages of the DL's were generally found to be slightly smaller and the distribution around these averages was normal. According to our knowledge, Jerger's group of normal hearing subjects was composed of audiology students, who must be considered as skilled or at least semiskilled listeners. Being tested in their own field, it must be assumed that they had a higher degree of motivation than the subjects used in the present investigation; and the effect of training has already been discussed. This difference in the quality of the listener material could easily account for the discrepancy between the results of these two studies.

‡ References 7, 9, and 10.

The general shape of the curves in Figure 8 is the same as that found by all previous investigators; that is, displaying relatively high values at low SL's, the DL tends to decrease toward a minimum at higher SL's. But the shape of these average curves and their statistical limitations after all may not necessarily represent the best measure of normalcy. Although the curves of the averages in Figure 8 could be reasonably well satisfied by an exponential equation, curves of very different slopes can be visualized to fit within these limitations. It should be tried therefore to see how well individual curves fit the specific pattern calculated for each average. Since these calculations would be quite time-consuming, a substitute expression might be sought.

Lüscher and Zwislocki [9] went to the extreme in this respect by testing the DL at one SL only, namely, at 15 db. Although expressing the result by a single number representing an absolute value of the DL, this expression of the test result loses all information as to the general shape of the curve. For this reason Naunton and Denes suggested expressing the results by the difference in DL between SL's of 10 and 40 db. This expression retains information as to the slope of the curve, but lacks that of the absolute value of the DL.

By sacrificing the use of a single index figure, both of these methods can be combined by plotting the slope, that is, the difference in DL at sensation levels of 10 and 40 db. (D_{10-40}), against the absolute value of the DL at the SL of 10 db. (DL_{10}).

Using the data from the same group of subjects of which Figures 7 and 8 were given, the results of this mode of plotting, this time for all five carrier frequencies, are presented (Figure 9) in a three-dimensional manner, with frequency of occurrence in each class interval (expressed as percentage ranges of the total of 195 ears) as the third dimension. The results appear shaped as a mound, the long axis of which has a distinctly positive slope, the distribution along this axis being skewed for most carrier frequencies.

It is now obvious that Figure 8 does not represent the individual curves very well, because the latter ones are not given as a family of parallel curves, but rather as a set of converging ones. To be specific, curves which start out at high absolute values (large DL_{10}) have a steep slope, and vice versa. Within the limits of our graph, the relation between DL_{10} and D_{10-40} seems to be linear. At each individual level of DL_{10} the spread is rather narrow, so that deviations from the normal are easily recognized.

It can be seen from Figure 9 that the occurrence of low initial values of the DL associated with small slopes of the curves is not exclusively associated with the phenomenon of recruitment, as was suggested in some of the previous publications. Even among normal hearing subjects, there is a gradual transition from high initial values with steep slopes to low ones with small slopes. With the material at hand, we are in no position to judge how well pathological cases can be delineated from this normal range. It is felt, however, that the method here described of plotting an initial value of the DL against the

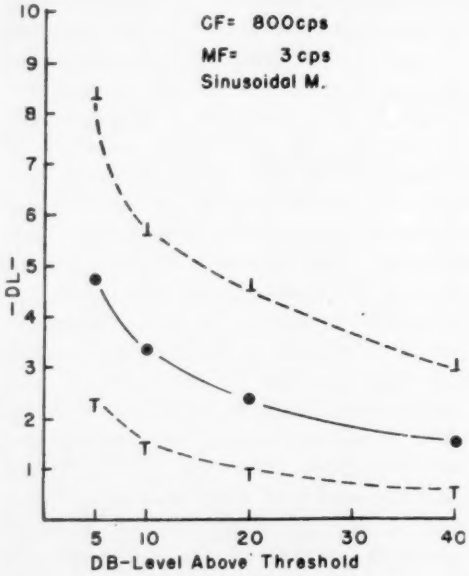


Fig. 8.—DL of intensity *vs.* sensation level (values of Figure 7 presented as averages and 90th centile); carrier frequency and modulation rate as indicated.

slope of the curve is best suited for this purpose.

In conclusion regarding this point, it might be mentioned that an attempt to combine these two factors into a single index figure was made by dividing the difference in DL at sensation levels of 10 and 40 db. (D_{10-40}) by the absolute value of the DL of 10 db. (DL_{10}) and thus forming what might be called the percentage difference. The distribution around the average (as might be expected from Figure 9) again became so large that the use of this combination can scarcely be recommended. In addition, the use of combinations of other SL's (5 and 20, 10 and 20, etc.) was tried, but 10 and 40 gave the narrowest distribution if comparison was made from the same subject material.

DL IN NOISE

The DL was determined under conditions of masking on a group of 50 subjects (91 ears), in an attempt to simulate "recruitment" in normal hearing listeners. To this end, wide-band noise was introduced to the same earphone used for the DL test. A matching pad was inserted into the circuit to prevent interference between the two signal channels. A carrier signal of 800 cps was employed throughout, and masking levels of 30, 50, and 70 db. were established in subsequent tests. Plotted in the manner of Figure 9, i. e., absolute values (DL_{10}) *vs.* the slope (D_{10-40}), the results of these tests are given in Figure 10. Except for the slight increase in the DL at the 30 db. masking level, which was only of probable statistical significance, there was no change in the DL induced by the masking noise. It was established in previous studies § that with the aid of loudness-balance measurements recruitment can be distinctly demonstrated at these masking levels. These unexpected results of the present study prompted the investigation of the correlation between DL-test results and those obtained from loudness-fractionation measurements, as mentioned earlier. DL's of intensity (Figure 11) are plotted at their appropriate places on Steven's loudness-function curve.[16] The vertical extrapolations of these lines represent their equivalents in terms of loudness. The relation between the two measures, DL of intensity and minimal perceptible increment of loudness, is simple, namely, within the range of our measurement the first equals the square root of the latter. As seen from Table 4, in which this comparison is carried out for the four sensation levels tested in our study, the agreement is quite satisfactory, i. e., it would be perfect if the values in column five, which represent units of loudness, would equal 1.0 for all cases. Included in Figure 11 are equal-loudness-balance measurements for masking levels of 10, 20, and 40 db.[17] Also included are curves resulting from integration of DL measurements taken at the same masking levels. The difference between these two sets of curves is too large and too consistent to be accounted for by inaccuracies in the measuring technique.

On the one hand, if threshold shifts are comparable, loudness-balance measurements are known to yield recruitment curves practically identical in pattern in cases of hearing loss of cochlear origin as well as in normal ears under masking conditions. On the other hand, DL measurements demonstrate "recruitment" in the first case, but fail to do so in the latter.

Two conclusions are inevitable from these findings:

1. In case of cochlear impairment, recruitment is not identical to that observed in normal ears under masking.
2. Loudness-balance and DL measurements do not measure the same phenomenon.

TABLE 4.—*Conversion of DL Values into Millisones*

1. Sensation Level (Db.)	2. DL (Db.)	3. Limits of Range (Db.)*	4. Corresponding Range in Millisones (Limits)†	5. Difference Between Square Roots of Values in 4
5	3.41	6.53 3.12	6.88 2.66	.95
10	2.27	11.06 8.79	19.1 11.9	.91
20	1.43	20.68 19.25	100.0 82.2	.96
40	0.92	40.44 39.42	1047.0 977.0	1.2

* From conversion tables (Brogan [1]).
† From loudness-function curves (Stevens).

§ References 14 and 17.

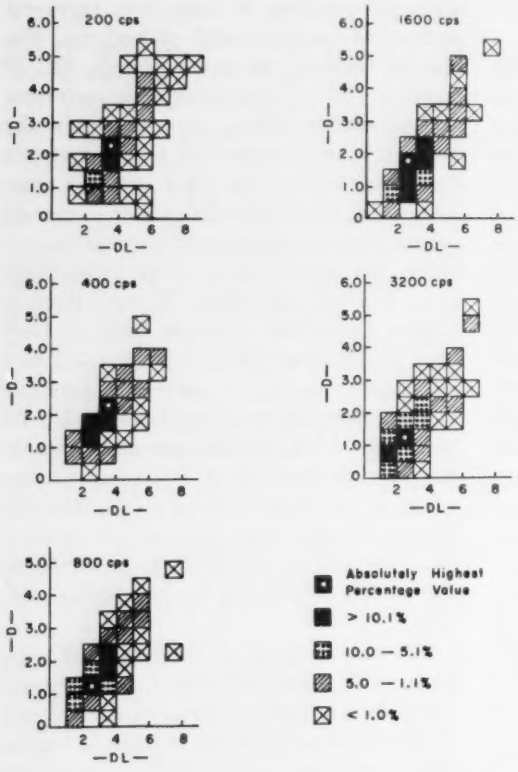


Fig. 9.—DL of intensity (at 10 db. sensation level) *vs.* difference in DL at 10 and 40 db. sensation level (i. e., "slope") with frequency of occurrence as parameter (key included); results for five carrier frequencies.

COMPARISON OF LOUDNESS LEVEL AND DL

It is easy to account for the first of these conclusions, as it is generally known that sensory and neural elements are actually missing in cases of cochlear pathology, while under masking their action is only altered. This statement should suffice here, without going into the argument of the actual mechanism of masking.

The second conclusion can be tested from another point of view. DL measurements definitely indicate that loudness increases in a quantal manner. Fechner || postulated that loudness levels are a simple function of the DL, that is, loudness increments result from additive responses of one singular sensory or neural element. The DL measurements for testing recruitment (mentioned above) which were introduced by Lüscher and Zwislocki [9] were based upon this hypothesis. If Fechner's hypothesis were true, which appears unlikely in view of the results presented above, then loudness levels should not only represent discrete steps along the scale of loudness, which they actually do, but, in addition, there should be a dependence on a fixed reference point (i. e., momentary threshold) in such a manner that DL would be a stepwise rather than a continuous function of the sensation level. The latter was tacitly assumed in the construction of graphs, such as Figure 8. Illustrating this by the method of graphing used in Figure 11 would mean that DL should not alter gradually within a smooth envelope, such as is indicated schematically in Figure 12*A*; but rather it should alter in a discontinuous manner, of which two possibilities are suggested in Figure 12*B* and *C*.

In order to test this hypothesis, we had to determine the consistency of DL measurements in repeated tests (i. e., the in-subject variation). This was carried out on only two

|| Fechner, cited by Guilford.[2]

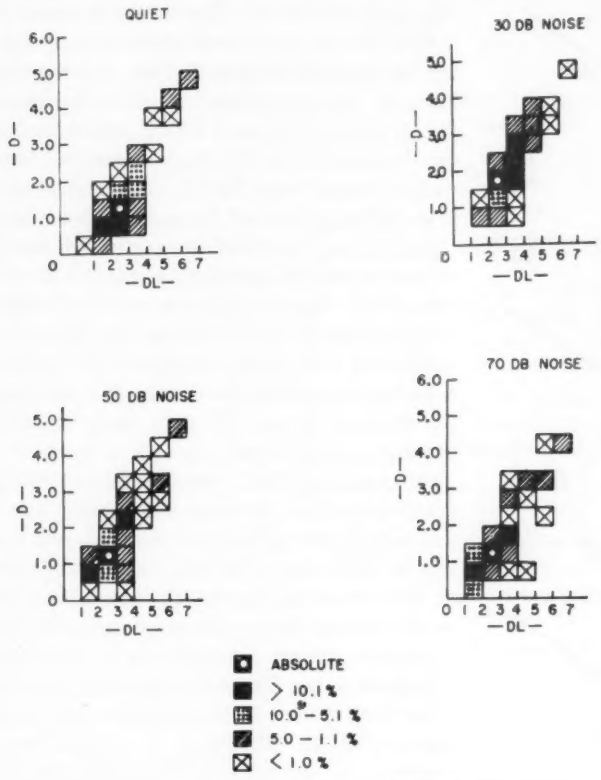


Fig. 10.—DL of intensity (at 10 db. sensation level) *vs.* "slope" in the manner of Figure 9; carrier frequency: 800 cps; parameter: background noise (levels from "quiet" to 70 db.).

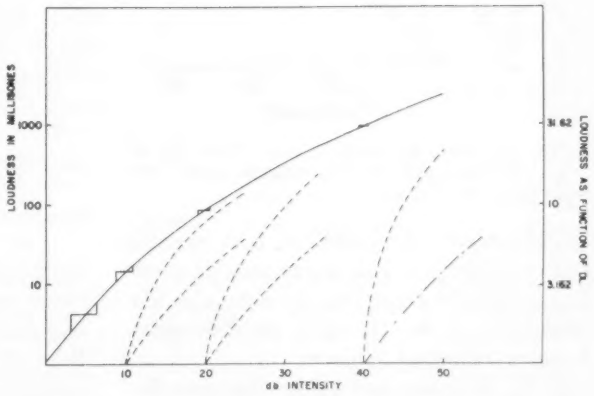


Fig. 11.—Loudness in millisones *vs.* intensity in decibels (modified after Stevens and Davis[16]). Solid curve: no masking; DL of intensity plotted in at appropriate places (i. e., at 5, 10, 20, and 40 db. sensation levels). Dashed curves with masking, resulting in threshold shifts of 10, 20, and 40 db. respectively. The set of steep curves was derived from loudness-balance tests,[17] showing recruitment, while the others, stemming from DL tests, show no recruitment.

skilled listeners, since accuracy of testing was of prime importance in this portion of the experiment. The investigators used a carrier frequency of 800 cps and a sensation level of 5 db. for this repeated testing. After the DL was assessed once in a descending manner, it was crossed repeatedly from below and above in a random fashion so as to give a minimum of clues to the listener. There were 20 presentations of the signal given during one test run, resulting in an average of 15 DL determinations. Three or four such test runs were completed in each session, allowing a one-minute interval between each test run. Each subject underwent three sessions. As an example, the results of two typical sessions are shown in Figure 13. Summary of results given in Table 5 indicates that in

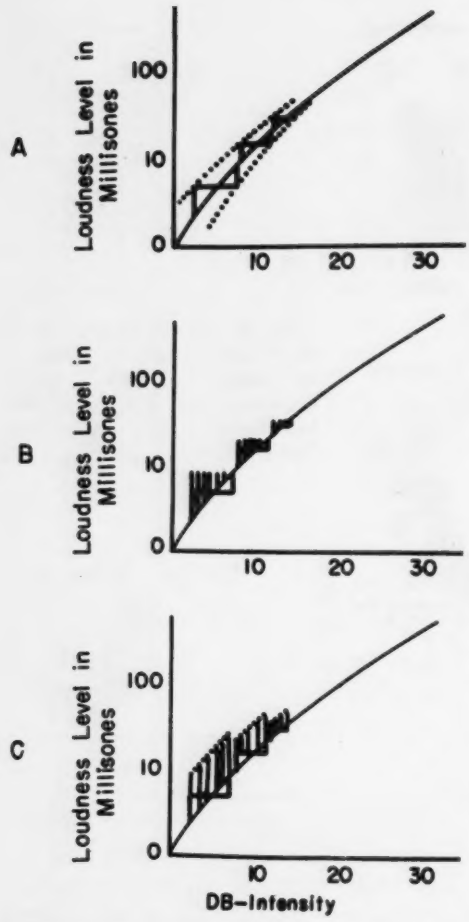


Fig. 12.—Three hypothetical cases (A to C) of DL of intensity plotted upon loudness curve (for explanation see text).

skilled subjects the variations, both over-all and per single test run, are reasonably small and apparently depend more on the absolute magnitude of the DL than on differences between individual subjects.

Using the same two skilled listeners, the investigators next made an attempt to prove the above hypothesis. The carrier frequency of 800 cps was again used. After finding the DL for a sensation level of 5 db., the carrier intensity was increased in steps smaller than the DL (i. e., ½, 1, and 2 db.) until a sensation level of 10 or 11 db. was reached. At each of these levels the DL was determined in a statistical manner by applying four test runs such as described above. In addition, test runs were conducted in the reverse direction (i. e., from a sensation level of 10 db. downward). Finally, because the latter is admittedly a strenuous type of testing, "quick runs" were conducted in which only four determinations of the DL were made at each carrier intensity level.

Although at times no significant differences were found between successive carrier intensity levels and even occasionally the result at the higher level was larger than that at the preceding lower one (as would be expected from the results presented in Table 5), there was no indication of a stepwise alteration of the DL as a function of the SL. Therefore, it must be assumed that DL, as a function of the SL, varies in a continuous manner, as was schematically indicated in Figure 12*A*. This, then, makes it even more unlikely that loudness levels are a direct function of the DL. In neurophysiological terms it means that the DL does not result

TABLE 5.—*Variation of DL in Successive Tests on Two Skilled Listeners*

	Subject A	Subject B
Number of test runs in three separate sessions	10	10
Average number of DL assessments per test run	15	15
Total number of DL assessments	147	151
DL (average of total) (db.)	3.3	2.9
Standard deviation (db.)	0.2	0.09
Standard deviation per test run (average value) (db.)	0.7	0.6

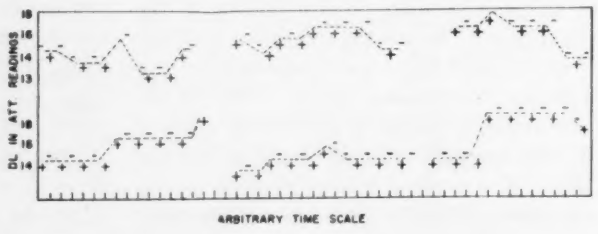


Fig. 13.—Results of six DL "test runs" (DL-attenuator readings *vs.* arbitrary time scale). The plus sign indicates that modulation was recognized, the minus sign that modulation was not recognized.

from the additive response of one singular sensory or neural element, but represents the results of a rather complex integration of responses of such elements. In this respect the phenomenon of neural inhibition may prove helpful. According to this phenomenon, first described by Galambos and Davis,[5] simultaneous propagation of impulses in some fibers and inhibition in others may indeed lead to a complex total. The discrepancy described above between DL and loudness-balance measurements in impaired ears and in masked normal ears indicates that this integration does not always lead to comparable results.

It is not at all our opinion that measurement of the DL is a worthless procedure, but that its alteration does not in all cases parallel the appearance of recruitment. It is suggested that clinical cases be used in making a comparison between loudness-balance and DL measurements in an attempt to further subdivide the phenomenon of recruitment into two classes—those with and those without alteration of the DL.

SUMMARY

Using a method of regular modulation, the DL of intensity was investigated from the aspect of several stimulus parameters: (1) ascending and descending mode of testing, (2) frequency and intensity of the carrier, and (3) pattern and frequency of modulation. Averages and ranges of distribution were established, using large groups of normal hearing subjects.

In contrast to the alteration indicated by loudness-balance measurements, there is no change in the DL after introduction of masking noise. In addition, the DL is found to be a continuous function of the sensation level, although in itself it represents a quantal entity. These two findings are taken to indicate, contrary to the classical concept, that loudness is not a direct, but a complex function of the DL.

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Case Reports

DILATATION OF THE PHARYNGOESOPHAGUS FOLLOWING TOTAL LARYNGECTOMY

Repair with Fascia Lata

ARTHUR J. CRACOVANER, M.D., New York
and
ALAN S. RUBENSTEIN, M.D., Wilkes-Barre, Pa.

A REVIEW of the medical literature fails to reveal any specific reports of dilatation of the pharyngoesophagus as a complication of total laryngectomy. The condition is not rare, for one frequently encounters postlaryngectomy cases in which a bulging of the lower portion of the neck is seen on swallowing and on exercising esophageal speech. There is also a complaint of a gurgling sound on swallowing and speaking.

While the dilatation of the pharyngoesophagus is relatively common, we had never seen a case that was severe enough to require repair. The patient we are reporting had such a large dilatation that he had difficulty in swallowing, which interfered with his nutrition. He also was unable to master esophageal speech.

It is understandable that dilatation of the pharyngoesophagus occurs frequently following removal of the larynx. To a very great degree, if not completely, the extrinsic support of the pharyngoesophagus is removed by the operation. The more radical the procedure, the more complete the loss of support. In addition to this there exists a possible weakness at the suture line, and if sepsis and fistulization occur, further compromising of the closure takes place. The latter, however, seems much more likely to lead to stenosis than to dilatation, although a partial stricture may cause dilatation of the pharyngoesophagus above it. Stenosis is a more likely complication of laryngectomy and one that the operator by his technique attempts to prevent.

Peculiarly enough, our present case did not have a stricture, although one would expect a narrowing to have caused the extreme dilatation of the pharyngoesophagus that occurred. The explanation of this may be found in the fact that the patient had a postoperative hemorrhage, and on the fourth day the wound had to be reopened in order to control the bleeding. This may have caused weakness in the wall enough to lose adequate support and produce subsequent dilatation of the pharyngoesophagus. There was no postoperative fistula.

The patient had difficulty in swallowing because he could not press the food into the esophagus with the weak dilated wall of the pharyngoesophagus. He could not master esophageal speech because the dilatation of the upper esophagus prevented approximation of the membrane surfaces of the vibrating cricopharyngeal sphincter, which is the mechanism of speech in the laryngectomized patient.

Support was given to the dilated pharyngoesophageal wall by placing strips of fascia lata across the dilated area. This maintained a firmness sufficient to permit proper deglutition and to master esophageal voice.

REPORT OF A CASE

History.—A. L., a 55-year-old white man, was first seen in the Outpatient Department of the New York Eye and Ear Infirmary on Aug. 21, 1952, with a chief complaint of hoarseness of one month's duration and a 5 lb. weight loss. Past history revealed syphilis in 1927.

Examination of the larynx revealed a growth covering most of the right vocal cord, extending

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From the Department of Broncho-Esophagology and Laryngeal Surgery, New York Eye and Ear Infirmary.

subglottically. On Sept. 18, 1952, a direct laryngoscopy was performed and a large mass was seen springing from the anterior half of the right glottic and subglottic region. The pathological diagnosis was "squamous cell carcinoma, Grade 2, with moderate cornification." The chest x-ray was essentially normal. Wassermann was negative.

On Sept. 25, 1952, a total laryngectomy was performed. The postoperative course was complicated by hemorrhage from the wound for three days. On the fourth day the patient was returned to the operating room, the wound was reopened under local anesthesia, and bleeding vessels were clamped and tied. A total of 1500 cc. of whole blood was given during the bleeding episode. Following this, the postoperative course was quite smooth. The sutures were removed on Oct. 5 and Oct. 7, 1952. Patient was allowed to take food by mouth on Oct. 9, 1952, and was discharged from the hospital on Oct. 10, 1952, fully healed and without fistulization. While in the hospital, the patient had been on antibiotics.

The patient did well following his discharge except that he complained persistently of dysphagia and also was unable to achieve an effective esophageal voice in spite of apparent effort and adequate intelligence. After laryngectomy, an increasing amount of ballooning was noted just above the tracheal stoma. This was most prominent when the patient swallowed.

In September, 1953, and May, 1954, esophagoscopies were performed but no lesions or strictures were found. Patient was given an Ace bandage to wear around his neck, above the tracheal stoma. He reported relief of the dysphagia when the area was supported in this manner. On May 13, 1954, under fluoroscopy after a barium swallow a delay in the progress of the barium was seen at the level of the hypopharynx and upper esophagus. Large quantities of air were present in this part of the alimentary tract, and as the patient attempted to swallow gurgling sounds were heard. The radiologist reported dilatation of the pharynx and the cervical esophagus, but otherwise no lesions were seen.

On June 28, 1954, the patient was readmitted to the hospital and reoperated on. Under local anesthesia two strips of fascia lata were obtained from the left thigh, each strip about 8 in. long by 1 in. in width. The trachea was then sprayed with 10% cocaine, and a sterile endotracheal tube with an inflatable cuff was placed into the trachea. Under local infiltration anesthesia a collar-type incision was made about 2 in. above the tracheal opening. The skin was elevated superiorly and inferiorly. Laterally the platysma muscles were split so that the anterior margin of the sternocleidomastoid muscles could be exposed. At this point two strips of fascia lata were sutured into the sternocleidomastoid muscles and through the platysma muscle in such a way that a fairly rigid support was given to the pharynx. All dead space was closed by suturing muscle to fascia.

The postoperative course was uncomplicated, and the patient was discharged on July 6, 1954, with deglutition much improved. By January, 1955, the patient's speech was very much improved and his swallowing continued to be good.

SUMMARY

A case of dilatation of the pharyngoesophagus following total laryngectomy is reported. The dilatation was extensive enough to interfere with deglutition and esophageal speech. Repair and support of the pharyngoesophagus was accomplished by placing fascia lata strips across the neck extending from one sternocleidomastoid muscle to the other. The procedure permitted adequate swallowing and enabled the patient to master esophageal speech.

114 E. 72nd St. (A. J. C.).

APTYALISM DUE TO INTOXICATION WITH PHENYLBUTAZONE (BUTAZOLIDIN)

ALLAN H. WARNER, M.D., Forest Hills, N. Y.

PHENYLBUTAZONE (Butazolidin) has been used for arthritis and rheumatic disorders since its description in Switzerland, in 1949. Complications resulting from this medication have been noted, including blood dyscrasias, abdominal pain, reactivation of peptic ulcers with bleeding, vertigo, skin eruptions, anorexia, edema due to retention of sodium and water, which has caused cardiac decompensation. In addition, jaundice, stomatitis, lymphadenopathy, malaise, and pruritus have been reported.

The incidence of toxic effects runs as high as 40%. These effects usually occur early and necessitate the discontinuance of treatment. Deaths have been ascribed mainly to agranulocytosis and intestinal hemorrhage.

A careful postmortem study of a fatal case by O'Brien and Storey [1] demonstrated three types of lesions: polyarteritis nodosa, hypersensitivity angiitis, and granulomatous lesions, with the latter two predominating. Their patient had developed water retention, leading to heart failure and sudden death after a few days of seeming clinical improvement. There was no agranulocytosis or bleeding of any kind. It is interesting to note that the patient had complained of "dryness and soreness" of the mouth.

Because of these potential complications, phenylbutazone should be given only under close medical supervision.[2]

The case described below presents the feature of aptyalism, with apparent complete cessation of the production of saliva. There was an accompanying mild ulcerative stomatitis and multiform skin rash, resembling Stevens-Johnson syndrome. However, the patient did not exhibit conjunctivitis or urethritis.* The extreme discomfort of a continuously dry mouth, with the accompanying ability to swallow only liquids, was almost unbearable.

In the available literature, aptyalism has not been emphasized. Nassim and Pilkington [3] mention "seventeen complained of dryness of the mouth and throat . . . ." However, in my case, the aptyalism persisted for six months and was the chief complaint after the severe toxic manifestations had been controlled.

REPORT OF A CASE

The patient was a white woman, aged 53 years. Previous history of "myocardial damage" as interpreted from electrocardiogram. Tonsillectomy had been performed at age 13. The last menstrual period occurred at 49 years of age. She had occasional hot flushes and sweats. Para II; gravida II. Hemorrhoids were present. She has had low back pain since age 49 years, with marked trophic arthritic changes and rotary scoliosis in the lumbar spine, and a chronic iliolumbar ligamentous sprain with myofasciitis. A lump was removed from the left breast at age 46 years. The lump was a benign lesion. She had received intravenous procaine therapy and local injections of procaine in painful vertebral areas.

Phenylbutazone was taken in the following amounts: from March 19 to 25, 1953, 100 mg. four times daily; from March 26 to April 1, 1953, 200 mg. three times daily; from April 2 to 10, 1953, 200 mg. four times daily.

On April 11, 1953, superficial ulceration appeared on the buccal mucosa. The tip of the spleen was palpable. A few petechiae were seen scattered on the face, chest, and abdomen. Oral temperature was 98.6 F.

On April 12th, the temperature was between 101.4 and 104 F. The patient felt extremely ill. Epistaxis and melena were seen. Petechial rash was present, as on April 11th.

April 13th, the temperature ranged between 102.4 and 104 F. Respirations were 16 to 22 per minute. The pulse was between 70 and 108 per minute.

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* References 4 and 5.

April 14th, a macular rash appeared on the face and trunk. The temperature ranged between 102.6 and 104 F. The patient appeared desperately ill.

April 15th, the temperature was 103.8 F in the morning. Cortisone was given by mouth (25 mg. every four hours). By the afternoon, the temperature was normal and the patient felt very much better.

April 16th, the macular rash and petechial rash disappeared. The patient felt very well.

During the next few days, the temperature on three occasions reached 101 F, following which the temperature remained normal and the patient remained clinically improved. The ulcerations of the mouth disappeared soon after the temperature returned to normal.

A sore throat and a sour taste persisted, in addition to which a marked dryness of the mouth appeared. The entire tongue and buccal mucosa were absolutely dry, causing great discomfort. As far as could be determined, the salivary glands were not secreting enough saliva to be recognizable. The various salivary glands were normal to palpation and were neither painful, tender, nor enlarged. A few vesicles and a small cyst appeared on the buccal mucosa of the lower lip.

In October, 1953, the mouth became slightly moist and gradually regained its normal moistness, and has remained so up to June, 1954. Some vesicles appeared intermittently on the lips and disappeared spontaneously. In addition to the cortisone therapy, supportive therapy was given, including liver injection crude and vitamin B_{12} parenterally.

The following are the pertinent laboratory findings:

Urine 1.028, albumin none, glucose none, acetone none, 3 to 7 white blood cells, occasional granular cast, occasional red blood cell.

Heterophile body reaction: April 12, 1953, positive up to 1 to 56; April 15, 1953, positive up to 1 to 56.

Bleeding time 7 minutes. Coagulation time 2½ minutes.

Platelet count 110,000. Throat smear for Vincent's organisms negative.

Blood urea nitrogen 13.0 mg. per 100 cc.

Fasting blood sugar 118 mg. per 100 cc.

Widal agglutination test negative.

Blood culture negative.

On the most recent examination (June 21, 1954) salivary flow was normal. The patient complained that the tongue "feels funny" and that there is a burning sensation of the tongue and oral mucosa. She stated that a "sour" taste in the mouth persists.

Blood Counts

	4/2/53	4/9/53	4/12/53	4/13/53	4/14/53	4/16/53
RBC	....	....	4,110,000	3,580,000	3,600,000	3,800,000
WBC	4,500	5,200	8,400	7,000	10,200	6,000
Polymorphs	68%	72%	71%	76%	89%	80%
Segmented cells	68%	72%	36%	74%	71%	70%
Band forms	....	....	35%	2%	18%	10%
Monocytes	....	....	3% *	1%	2%	....
Lymphocytes	32%	28%	26%	21%	9%	17%
Eosinophiles	....	....	....	2%	....	3%
Hgb	....	....	11.2 gm.	11.2 gm.	10.9 gm.	11.8 gm.

* Two cells resembled infectious mononucleosis.

This case resembled Stevens-Johnson syndrome, having had a rash similar to erythema multiforme with stomatitis. However, the patient did not exhibit conjunctivitis or urethritis.

Cortisone achieved a dramatic clinical improvement in the acute manifestations.

97-01 66th Ave.

SUMMARY

A case is presented in which salivary gland shutdown, and other toxic symptoms, developed during the course of phenylbutazone (Butazolidin) therapy. The aptyalism persisted for approximately six months, finally subsiding spontaneously.

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UNILATERAL AND BILATERAL LIGATION OF THE EXTERNAL CAROTID FOR EPISTAXIS

ADOLPH WOLFERMAN, M.D.
and
FRANK P. DWYER Jr., M.D., Baltimore

EVERY physician, whether in general practice or specialty, has had experiences with epistaxis. There are those cases that are cured simply by the insertion of a small piece of cotton into the anterior nare, and there are other cases that require almost uninterrupted medical attention for days or even weeks, causing many a sleepless night to physician and patient. A case of epistaxis that cannot be brought under control by repeated packings (anterior and posterior), blood transfusions, and watchful waiting is certainly a rarity. Some authors even claim that all cases of (uncomplicated) epistaxis can be controlled by this regimen. After having reviewed the literature on the subject and having considered our own experiences in this line, we believe that there are cases of epistaxis that cannot be controlled by these procedures and require such heroic measures as ligation of one or several major blood vessels. Ligation of the external carotid artery for uncomplicated epistaxis is advised only as a last resort, when all conservative measures have failed and when the blood loss is of such severity as to endanger the patient's life. Under these circumstances, according to Ogura and Senturia, ligation of the external carotid becomes a lifesaving act. This view is shared by many others. Considering the great number of cases of epistaxis the otorhinolaryngologist is called upon to treat, one so rarely has to resort to this procedure that most men feel it worth while to report their cases or series of cases of carotid ligation for epistaxis and to relate the circumstances.

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In 1917, Bartlett and McKittrick listed 105 cases of ligation of the common carotid found in the literature until that year. The first reported case was done in 1795 by Mr. Abernethy. His patient died. The first patient who survived the procedure was reported by Fleming in 1803. Among the 105 cases the mortality rate was 33.3%. Seven cases were done for hemorrhages from the nose, nasopharynx, or oropharynx, with three fatalities. One of these fatalities was a bilateral ligation, with death ensuing the following day. All these cases were ligations of the common carotid or carotids. Why ligation of the external carotid was not tried in these cases is not explained. Reporting one case of ligation of the external carotid for the control of idiopathic nasal hemorrhage in 1925, Hyde was also surprised not to have found a case of ligation of the external carotid in idiopathic epistaxis reported in the literature for the five preceding years, while ligation of the common carotid was reported rather frequently.

McKnight in 1926 reviewed the literature and found 17 cases of external carotid ligation reported. In his own case he ligated the common carotid as well. No mention is made of the anterior ethmoids. He recommends placing the ligature on the external carotid away from the bifurcation, so that in case it becomes necessary to ligate the common carotid later blood can still flow to the internal carotid through the anastomosis between the two external carotids and the bifurcation.

The next case was reported by Abrahams in 1928. This author, too, expresses amazement at the scarcity of reports on this pro-

cedure. His indications are recurrences of epistaxis and low red blood cell count. In his case the hemoglobin was not below 60%. He also noted that within a few days the circulation is completely reestablished by means of anastomosis with the other external carotid, and for the first time we find mention of bilateral external carotid ligation, which, according to him, produces only a temporary local anemia.

Hawthorne, in 1930, insisted on ligation without delay when confronted with repeated outbursts of severe hemorrhage and failure of adequate packing to control them.

Strauss, in 1933, reported a case of epistaxis in pregnancy where ligation of the external carotid was a lifesaving measure. He commented especially on the absence of mortality for this surgical procedure, while the mortality in ligation of the common carotid is at least 10%. He states that ligation of the external carotid for epistaxis had been successful in every case reported.

Ogura and Senturia, in 1949, surveyed the cause and treatment of epistaxis and reported four cases of ligation after all other measures failed. They leave no doubt that they consider the procedure as lifesaving in certain cases.

Spar and Hallberg reported their experiences in the treatment of severe epistaxis at the Mayo Clinic and found 11 cases that required ligation, none of them bilateral. Their indications were failure of repeated transfusions and packing and fall of blood pressure, which, they insist, may lead to coronary occlusion in the older age group.

From this review of the literature, it appears clear that there are very definite indications for ligation of the external carotid artery in severe epistaxis. Peluse and Fischler state that "in case of severe uncontrolled epistaxis in which it is impossible to establish the bleeding point after careful suction and inspection, ligation of the external carotid is the procedure of choice." Whenever epistaxis endangers the life of a patient, one should resort to this procedure. Blood pressure and blood cell count, availability of blood for transfusions and of prompt expert medical care—all these factors have to be taken into consideration in order to come to a decision. When daily transfusions of 1 to 3 pt. of blood fail to raise the hemoglobin level above 60% and to maintain a normal blood pressure or when, after two to three weeks of expert packing and other intranasal treatment, the bleeding continues to be profuse, the time for surgical intervention has come.

The technique should not present particular difficulties. According to Horsley and Bigger, the average length of the external carotid is 6 cm. from the bifurcation to the point of division into the internal maxillary and superficial temporal arteries within the parotid gland. The conventional incision runs a little posterior to the anterior border of the sternocleidomastoid, from the middle of the thyroid cartilage to the angle of the jaw. The posterior belly of the digastric muscle appears at the upper angle of the wound, and the hypoglossal nerve crosses the external carotid. The artery is, of course, identified by its branches. According to Bancroft and Humphreys, occasionally no trunk is present but only branches are seen. Transverse veins, inconstant in size and number, lie superficial to the arteries and have to be noted. Communicating branches between the facial and external jugular veins may have to be ligated and divided in order to expose the artery. The first portion of the artery is superficial and covered by skin, subcutaneous tissue, superficial fascia, platysma, deep fascia, and the edge of the sternocleidomastoid muscle. The superior thyroid, lingual, and facial arteries come off anteriorly, and the occipital, posterior auricular, and ascending pharyngeal branch off posteriorly. Most physicians place their tie between the superior thyroid and the lingual. Horsley and Bigger advise placing the tie below the superior thyroid and ligating the branches also. It might also be well to remember that in its first portion the external carotid lies internal to the internal carotid. At times adhesions between the external and the internal carotid will have to be carefully dissected before the vessel can be tied.

Which type of epistaxis is most likely to become severe enough to require carotid ligation? To answer this question, we have to investigate the anatomical and etiological factors involved. It is obvious that carotid ligation will only benefit those cases where the bleeding comes from a vessel supplied by the external carotid. The largest vessel supplying the nose is the sphenopalatine artery, a terminal branch of the internal maxillary. This vessel, together with the descending palatine artery and the pharyngeal artery, supply the posterior-inferior part of the nasal cavity, while the anterior-superior part is supplied by the anterior ethmoids fed by the internal carotid. Therefore, only bleedings of the posterior part of the nasal cavity are suitable for external carotid ligation. If the bleeding comes from the anterior part of the nose, external carotid ligation would be of no value, besides the fact that the bleeding point will sooner or later be visualized and cauterization can be applied. Only occasionally will one have to resort to ligation of the anterior ethmoid. It must be mentioned, however, that there is an anastomosis between the posterior ethmoid (from the internal carotid) and the sphenopalatine (from the external carotid). There are also rich anastomoses between the branches of the external carotid of both sides. All cases of Spar and Hallberg and of Ogura and Senturia involved posterior bleeding.

Hallberg lists the following local and general causes of epistaxis: trauma, infection, traumatic septal perforation, neoplasm, and hereditary hemorrhagic telangiectasis being local; hypertension, arteriosclerosis, high venous tension (in emphysema, bronchitis, mitral stenosis), and blood dyscrasias being general. According to him, there is seldom a deficiency in the clotting mechanism but rather a leak in the side of the vessel without tendency to closure. Forty per cent in Spar and Hallberg's series had arteriosclerosis, and 40% of their patients were over 60 years. All their ligations belonged to these groups. Ogura and Senturia found that 60% of their older cases had hypertension. External carotid ligation is therefore most likely to be necessary in the older patient suffering from arteriosclerosis or hypertension and bleeding from the posterior part of the nose.

We should like to report two cases of severe epistaxis that we have observed during the last 12 months, both requiring external carotid ligation, one of them bilateral.

REPORT OF CASES

Case 1.—Mrs. S. K., aged 23, housewife. There was nothing of significance in the family history. Patient had infantile paralysis at the age of 11, but recovered fully. She reported no other hospitalizations or surgery. There was no history of previous epistaxis.

Three days prior to admission patient started to bleed profusely from the right nostril. She was treated and packed repeatedly at another hospital but continued to bleed. On July 24, 1954, she reported to our emergency room. We found a thin, asthenic-looking woman bleeding freely from the right nostril. Lips and conjunctivae were very pale. Heart, lungs, and abdomen revealed no pathology. Patient was menstruating rather profusely, which, according to her, was not unusual. There was no genitourinary pathology. On inspection of the nose the blood could be seen coming from the right middle meatus posteriorly. No bleeding point was visualized. A large amount of blood was also seen in her pharynx. Tight anterior and posterior packs were inserted, and the patient was admitted to the hospital. Laboratory findings showed a hemoglobin of 57% and red blood cells 2,900,000; 1 pt. of whole blood was given immediately. Bleeding time was 1 minute, and coagulation time, 3 minutes. Platelet count was 208,000; blood pressure on admission, 100/60 mg. Hg. Several times during the day the patient vomited fairly large amounts of dark, and at times bright, blood. The following day her blood cell count remained the same. There were several episodes of profuse bleeding through the packs, and the posterior pack was changed and another pint of whole blood given. For the following eight days the patient continued to bleed off and on profusely. The packs were changed several times; coagulants were given parenterally, and narcotics and sedatives were used freely. During this period 7 pt. of whole blood were given, which were unable to prevent a considerable fall of the hemoglobin level.

These are the laboratory reports:

	7/24	7/26	7/27	7/28	7/30	7/31	8/2
Hb., %	57	58	48	42	40	61	38
RBC	2,900,000	4,130,000	3,440,000	2,610,000	2,260,000	3,870,000	1,690,000

On Aug. 2, it was felt that conservative treatment was unlikely to be of further benefit and that further blood loss might be dangerous. Ligation of the right external carotid was decided upon and performed under local anesthesia. The vessel was readily exposed and ligated with three black silk ligatures. While the patient was still on the operating table, all packs were removed from the nose. The patient continued to bleed profusely from the right nostril, however, and anterior and posterior packs had to be reinserted. During the next two days some more fresh bleeding, at times rather profuse, was observed, but with the help of blood transfusions the Hb. level rose steadily, and on Aug. 5 the bleeding seemed to have definitely stopped. All packs were removed, and no bleeding recurred.

	8/4	8/5	8/6	8/7	8/9
Hb., %	50	59	66	65	71
RBC	2,390,000	2,490,000	3,770,000	2,252,000	3,240,000

Nasopharyngoscopic examination revealed no abnormality except for a streak of dark clotted blood near the posterior margin of the septum. The patient was discharged on Aug. 9 and has not been heard of since.

CASE 2.—Mr. L. J., Negro, aged 58, janitor. There was nothing of significance in the family history. Patient had had the usual childhood diseases. He reported no other hospitalizations or surgery. There was no history of previous epistaxis. He had always been in good health and participated in various athletic activities during his younger years. Two years previously he was examined for some epigastric pains but no organic lesions were found.

His epistaxis began one week prior to admission, allegedly after an attack of heavy sneezing. Treatment outside the hospital was of no avail, and patient continued to bleed off and on from the left nostril until Dec. 27, 1954, when he reported to the accident room at 8 a. m. At that time the bleeding was not particularly impressive. An anterior pack was inserted into the left nostril, and the patient was discharged. One hour later, however, the patient returned, bleeding profusely from nose and nasopharynx. No bleeding point could be visualized, but the bleeding came obviously from the posterior part of the nose. Tight anterior and posterior packs were inserted; sedation was given, and the patient was hospitalized. Physical examination revealed normal heart and lungs and abdomen. There was some evidence of arteriosclerosis in the eye grounds. No other pathology could be found. Blood pressure on admission was 110/75.

Laboratory findings: Hb. 55%, bleeding time 1 minute, clotting time 3 minutes, prothrombin time 100%, NPN 39.8 mg. per 100 cc., and platelets 220,000.

One pint of whole blood was given. The following day patient had improved considerably. His Hb. was 67%, with 4,970,000 red cells, 13,200 white cells, and a normal differential count. In the afternoon, however, he vomited about 2 pt. of blood and started to bleed profusely. He went into shock, and 2 pt. of whole blood were given immediately and the packings were changed. During the next two days the patient bled through the packs and went into shock several times. His blood pressure dropped to 90/70. He received 7 pt. of blood within 48 hours. He was put on an aqueous solution of oxalic and malonic acids (Koagamin), adrenochrome monosemicarbazone sodium salicylate complex (Adrenosem), ascorbic acid, and vitamin K, but he continued to bleed and to require blood transfusions for four more days, until Jan. 3, 1955, when the bleeding stopped. On Jan. 4 all packs were removed. His blood pressure was 150/80. On Jan. 8 he was discharged in good condition, with a Hb. of 62% and 4,610,000 red cells.

During the week following his discharge, the patient was seen twice in the outpatient department and no bleeding was observed. Nasopharyngoscopy revealed no pathology.

On Jan. 15, he reported again to the accident room, bleeding from the left nostril. No bleeding point could be visualized. Posterior and anterior packs were inserted tightly, and the patient was admitted to the hospital. He was in good condition, his blood pressure being 150/80 and pulse rate, 100. He continued to bleed through his packs during Jan. 16, however, and in the evening of that day blood pressure was 130/80 and pulse rate was 132. On Jan. 17, in the morning, the patient was in shock and irrational. Blood pressure was 110/60; pulse, thready; Hb., 36%, and RBC, 1,780,000.

Blood transfusion was started immediately, and the patient was taken to the operating room for left external carotid ligation under local anesthesia. After completion of the surgery, all packs were removed, but profuse bleeding persisted, and tight packs had to be reinserted immediately. In the evening of the same day, the patient started to bleed profusely from the right side while the left bleeding continued. The right side was packed at 8 p. m., and more blood was given, the fourth pint for that day. On Jan. 18 the blood pressure was 115/80; Hb., 39%, and RBC, 4,280,000. At 4 p. m. extremely severe bleeding from both sides was noted. All packs were removed, and anterior and posterior packs were reinserted very tightly in both sides, and the patient was given another blood transfusion.

It was now apparent that the ligation of the left external carotid had not been of any benefit to this patient. Not only did the left side continue to bleed, but the right side had also started to

bleed very profusely. The patient's condition became more and more serious, and it was clear that something else had to be done to save his life. It had been established previously that the bleeding was posterior. Therefore ligation of the anterior ethmoids was not considered. Immediately following operation and during the entire postoperative period no pulsations could be felt in the superior temporal artery of that side, although they could be felt easily on the side not operated on. This was confirmed by several consultants, and proved beyond any doubt that the external carotid had been effectively ligated. The only explanation for the persistent bleeding was that the vessel or vessels were fed by the right external carotid. After thorough consultation with several members of the hospital staff it was therefore decided to proceed with ligation of the right external carotid the next day, if no improvement could be observed.

The next day, Jan. 19, after considerable bleeding during the night, patient was dyspneic, his pulse was thready, and his temperature was 103 F; blood pressure, 120/80; general condition, poor, and Hb., 44%. He was taken to surgery, and the right external carotid was ligated. The packs were left in place. After completion of the surgery the patient was placed in an oxygen tent and blood transfusions were started. His general condition improved rapidly, and the bleeding stopped. At 4 p. m. the patient developed chest pains; his breathing became rapid and shallow; moist rales were noticed over the base of the right lung, and some frothy blood was coughed up, while nose and nasopharynx remained dry. Chest x-ray revealed congestive changes in the right lung but no gross consolidation. He was given very large doses of antibiotics and kept in an oxygen tent.

On Jan. 20, in the afternoon, the patient showed definite improvement. His blood pressure was 150/80. Temperature dropped to 101 F. There was no more bleeding, and he started to take nourishment.

This improvement continued throughout the following day. The temperature became normal, and the oxygen tent was removed. On Jan. 22 all packs were removed from the nose. From then on, the patient's condition improved steadily, and there was no recurrence of the bleeding. His Hb. remained low, but his red cell count became normal. On Jan. 29 he was discharged in good condition, with a Hb. of 50% and 4,390,000 red cells.

After his discharge from the hospital he was seen repeatedly in the outpatient department. His Hb. reached 75% with iron therapy. Nasopharyngoscopy revealed a somewhat pale nasal mucosa but no pathology. A thorough medical examination by competent internists revealed no pathology whatsoever, and the patient was able to resume his occupation.

COMMENT

We believe that in both these cases external carotid ligation was a lifesaving measure, after prolonged and active conservative treatment had had no results. In one case profuse bleeding persisted after unilateral ligation of the external carotid to almost a fatal outcome. This fact does not conform with the observations of other authors, especially with those of Johnson and Foster, who state that "in all cases reported bleeding did not recur at any time after ligation." This was also found to be true in the six cases done previously in this hospital since 1947. The only explanation for continued bleeding after ligation is that the bleeding vessel is fed by the external carotid of the opposite side. That means that in case of persistent dangerous bleeding after ligation of one external carotid the other external carotid must also be ligated. It appears to us that collateral circulation is established immediately after ligation of one carotid, and not only after several days, as Abrahams and others believe.

Neither unilateral nor bilateral external carotid ligation seems to cause any temporary or permanent inconvenience to the patient. The area served by these vessels is so well vascularized that no ischemic sequelae are to be expected. It appears to us therefore that, if severe posterior epistaxis is not checked by the ligation of one external carotid, one should not hesitate to ligate the other one, too.

5505 Groveland Ave. (15).

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UNUSUAL CALCIFICATION OF CRICOID CARTILAGE MASQUERADING AS FOREIGN BODY IN ESOPHAGUS

GEORGE S. RICHARDSON, M.D., Albuquerque, N.M.

THERE have been numerous reports of foreign bodies of the esophagus and objects masquerading as foreign bodies of the esophagus.

Manning [1] reported a case of calcified cervical node masquerading as a foreign body of the esophagus wherein a patient swallowed a bone (lamb) and an A-P roentgenogram showed an object thought to be the bone. The patient manifested clinical evidence of a bone or some sort of foreign body below the clavicle and behind the sternum. On esophagoscopy a whitish area was seen and grasped with grasping forceps without bringing out the foreign body. The final conclusion of his case was that a cervical node had calcified from some cause and was masquerading sufficiently as a foreign body to merit esophagoscopy.

REPORT OF CASE

J. N. M., aged 62, a farmer, entered the office on Dec. 7, 1953, with a complaint of pain in the throat. Pain was located at the midpoint of the right sternomastoid muscle and followed his eating a chicken dinner. He could swallow water and had eaten since the meal, but the pain persisted and brought him to the office.

On examination nothing was seen by indirect means, and temperature was normal by mouth.

He was referred to a radiologist, who reported that a bone of spicular character was located about 2 in. below the cricopharyngeus.

The patient was admitted to the hospital and esophagoscoped at 4:45 p. m., using the short and long Roberts esophagoscope. A bolus of chicken was removed, and a bone about 2 in. in length, probably a rib, with a covering of barium, was seen. One end of the Y had perforated his esophagus and was not covered by the barium. The bone was removed with grasping forceps, and the patient was placed on a perforation routine. Nothing was seen but barium on withdrawal of the esophagoscope.

On the following day it was discovered that the specimen had been thrown away by a surgical nurse and an x-ray revealed that the object reported by the radiologist as bone was still present. The question of a laceration with barium in it was considered or thought possible, and a period of watchful waiting passed. I had not shown the bone to the patient, unfortunately.

On Dec. 10, 1953, a secondary esophagoscopy was done and no bone, barium, or perforation was found. On Dec. 11 the pain had gone, and the patient was discharged on Dec. 12, 1953. A roentgenogram at this time showed the spicule of "bone" still present. He was last seen on Dec. 21, 1953, without pain and with no trouble eating, and a subsequent radiograph still revealed the unusual shadow.

COMMENT

It is interesting to note that this shadow had persisted throughout each esophagoscopy and that at no time was the real offender, removed at the first esophagoscopy, outlined or discovered at x-ray.

In view of the preliminary findings and after consultation with the radiologist the films were studied again. The preliminary findings in films showed a "bone" sliver probably 1 cm. in length in the "lowermost portion of the pharynx at the level of the cricopharyngeus." There was total obstruction to the passage of a barium-filled capsule below this point.

The film on Dec. 8, 1953, following preliminary esophagoscopy, was reported as follows:

The linear ossification noted on the film obtained Dec. 7, 1953 is essentially unchanged in position, although the most probable explanation is that it is a residual foreign body. The possibility that this represents an unusual ossification of the cricoid cartilage cannot be ruled out.

The specimen removed from the esophagus by esophagoscopy was reported by the pathologist as follows: "This bone measures 4 cm.

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Fig. 1.—X-ray taken on admission showing the spicule of calcification believed to be a foreign body.

Fig. 2.—X-ray taken the day following esophageal removal of a chicken bone, still demonstrating the original "foreign body." This view necessitated another esophagoscopy.

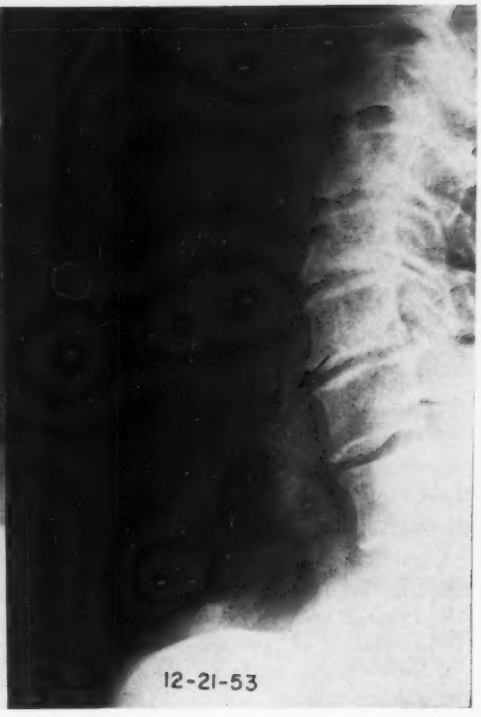

Fig. 4.—X-ray showing "linear calcification" viewed upon discharge as an "unusual calcification of the posterior portion of the cricoid cartilage which would simulate a foreign body."

Fig. 3.—X-ray showing no evidence of perforation of esophagus by chicken bone removed at initial esophagoscopy yet still presenting the linear ossification unchanged in position since initial films.

in length and approximately 2 mm. in diameter and has the normal structure of a chicken bone." (The surgical nurse had found the specimen on the following day when its importance was realized.)

Film dated Dec. 12, 1953: "Reexamination shows no appreciable change of the linear ossification in vicinity of the hypopharynx." Film dated Dec. 21, 1953: "Reexamination shows no change in the linear calcification. In view of the recent negative pharyngoesophagoscopy this must be interpreted as an unusual calcification of the posterior portion of the cricoid cartilage which would simulate a foreign body."

Cunningham [2] states:

> In old age, the thyroid, cricoid, and hyaline parts of the arytenoid may be completely ossified. The commonest sites of ossification are the posterior and lower margins of the thyroid and lamina of the cricoid cartilages.

A subsequent case of similar nature has been seen by the same radiologist * with findings in a similar location.

SUMMARY

A case is presented in which a linear calcification, presumed to be a linear calcification in the lamina of the cricoid cartilage, masqueraded as a foreign body of the esophagus after removal of a foreign body.

Photography by the Medical Illustration Department of The Lovelace Foundation.

201 Arno St., S.E.

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Clinical Notes, New Instruments and Techniques

A METHOD OF GENERAL ANESTHESIA FOR BRONCHOSCOPY AND BRONCHOGRAPHY

SYLVAN M. SHANE, D.D.S.
and
HARRY ASHMAN, M.D., Baltimore

According to Jackson,[1] the majority of physicians performing bronchoscopy and bronchography employ local analgesia with the patient cooperatively awake, and many use no anesthesia at all for children.

A number of reasons are advanced for not using general anesthesia:

(*a*) It is too dangerous.

(*b*) Extreme depth of anesthesia, almost to respiratory arrest, is required to produce relaxation sufficient to insert the bronchoscope. This produces delayed postoperative recovery and morbidity, especially when thiopental (Pentothal) sodium is used.

(*c*) Insufflated ether is of questionable value, since it creates a fog at the distal end of the bronchoscope which distorts visual acuity, and gases such as nitrous oxide and ethylene are rather impotent by comparison.

(*d*) General anesthesia is usually fluctuant, with a "see-sawing" plane, resulting in coughing, vomiting, reflex struggle, and ultimate trauma to the trachea, larynx, and teeth. This necessitates speed on the part of the bronchoscopist, and frequently observation is inadequate.

Bearing in mind the disadvantages and dangers of general anesthesia as well as the time loss, patient apprehension, and general discomfort of peroral endoscopy under local analgesia, we developed, in Baltimore, a safe efficient method of general anesthesia for these procedures, which has been in use at the Lutheran Hospital since 1952.

This method exhibits the following advantages:

(*a*) It is safe.

(*b*) The plane of anesthesia does not fluctuate.

(*c*) Ether is not used, regardless of age.

(*d*) Bronchoscopy and bronchography may be carried out for indefinite periods of time without a fluctuating plane and without the necessity for speed on the part of the surgeon and without apprehension on the part of the patient.

(*e*) Patients are fully awake within three to seven minutes of terminating the anesthesia.

(*f*) The danger of toxic reactions associated with local analgesia is obviated.

(*g*) The method to be described is applicable to all age groups.

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From the Department of Anesthesiology, Lutheran Hospital of Maryland.

ANESTHESIA TECHNIQUE FOR BRONCHOSCOPY IN PATIENTS UPWARD OF AGE 10

1. Premedication: atropine, 1/100 grain (0.6 mg.).

2. The average patient is anesthetized with a single dose of hexobarbital (Evipal) sodium (8 cc. of a 5% solution) or thiopental (16 cc. of a 2.5% solution) introduced by vein. The dose is regulated to accommodate the age and physical status of the patient. No additional hexobarbital or thiopental is required, regardless of the duration of the operation after this initial dose is given.

3. A rubber anesthesia mask is quickly placed on the patient's face, through which he breathes the following mixture in a semi-closed system, the blow-off valve being widely open:

Nitrous oxide .....1000 cc. per minute (approximately 45%)

Oxygen .....2000 cc. per minute (approximately 45%)

Cyclopropane ..... 300 cc. per minute (approximately 10%)

4. The patient should breathe this mixture for at least five minutes. This will level the patient off into Plane I anesthesia. (No matter how long the patient breathes this mixture, he will not descend deeper than Plane I, nor will the anesthesia lighten sufficiently for him to vomit or awaken.*)

5. A translaryngeal block is then performed by inserting a needle through the cricothyroid mem-

* References 2 and 3. A detailed description of the application of this method of anesthesia for use in general surgery along with a physiologic and pharmacologic appraisal of the method appeared in the June and September, 1954, issues of the *International Journal of Anesthesia*. These articles were later published on Feb. 1, 1955, under the same title in book form by Lowry & Volz, Publishers, of Baltimore.

brane, into the trachea, below the vocal cords, and 3 cc. of 1% tetracaine (Pontocaine) or 5% hexylcaine hydrochloride (Cyclaine) is injected. This will cause the patient to reflexly cough rather actively, which facilitates the spread of the local anesthetic.

6. When coughing ceases and normal respiratory rhythm is reestablished, 1.5 to 2 cc. of succinylcholine is injected to purposely produce respiratory arrest.

7. Respiratory arrest will ensue within one minute. The breathing bag is compressed rhythmically during this minute of progressively decreasing respiration in order to assure a well-ventilated patient.

8. When the patient stops breathing, the mask is removed and the bronchoscope inserted.

9. To the side arm of the bronchoscope is attached a long piece of rubber tubing. The anesthesiologist connects this tube to the anesthesia machine and reinstitutes the same flow of gases (cyclopropane, nitrous oxide, and oxygen) through the bronchoscope.

10. The patient will usually start to breathe on his own by the time the bronchoscope is inserted. If spontaneous respirations do not resume, the proximal opening in the bronchoscope may be intermittently closed off with the index finger, which will cause the lungs to inflate with the mixture of gases, in the identical manner in which an endotracheal tube and breathing bag are utilized.

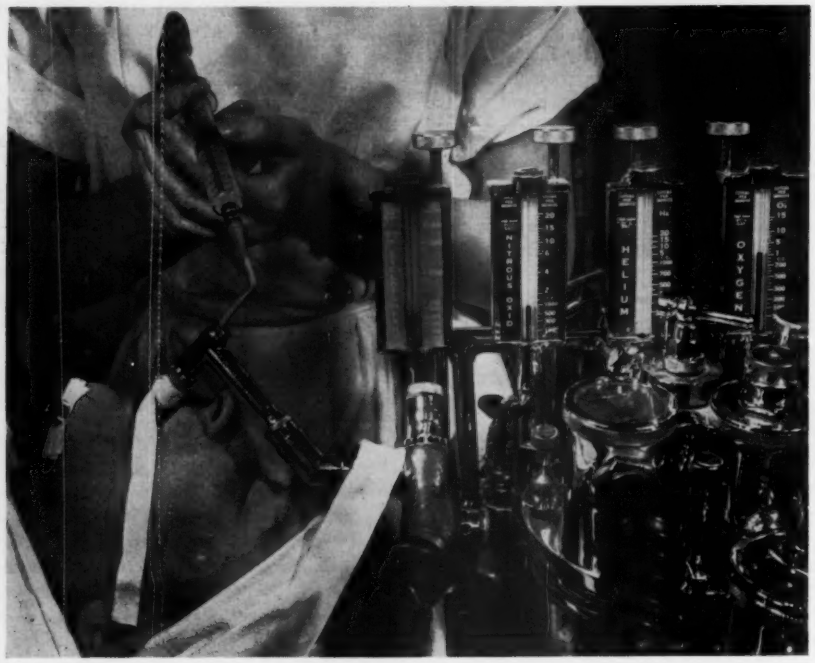
11. The patient will require no additional hexobarbital or thiopental. The flow of gases through the bronchoscope will maintain the patient in light Plane I anesthesia indefinitely. There will be no fog at the distal end of the instrument. It is important to stress that this mixture of gases will be more highly predictable in the maintenance of an even plane of anesthesia if thiopental or hexobarbital is employed as the induction agent.

12. When it is decided to remove the bronchoscope, the gases are discontinued and only oxygen is permitted to flow. When the patient shows signs of reflex awakening (usually within two minutes), the bronchoscope is removed.

TECHNIQUE FOR BRONCHOSCOPY IN CHILDREN AND INFANTS UNDER AGE 10

Children under age 10 may be managed in the same way as those upward of age 10, except that the dosage of succinylcholine and hexobarbital

Bronchography under general anesthesia. Propyliodone being injected via a rubber catheter inserted through the opening in an endotracheal elbow. The patient breathes the anesthetic gases which flow around the rubber catheter. The flowmeters are adjusted for cyclopropane to flow at 300 cc. per minute, N_2O at 1000 cc. per minute, and oxygen at 2000 cc. per minute. The open elbow does not interfere with the successful maintenance of a smooth anesthesia plane. If a more turbulent flow of gases is desired, each gas setting should be multiplied by two.



should be reduced according to age. The flow of gases remains the same regardless of age.

In infants and young children whose veins are difficult to enter we introduce anesthesia with vinyl ether (Vinethene), switch to open-drop ether until Plane II is attained, then insert the bronchoscope.

Through the side-arm of the bronchoscope is insufflated the same mixture of N_2O-oxygen-cyclopropane. In the absence of hexobarbital or thiopental as an induction agent the plane of anesthesia may vary somewhat and tend toward a lighter plane rather than depth. Unless some barbiturate is introduced, it may be necessary to increase the flow of cyclopropane from 100 to 200 cc. per minute for one or two minutes at a time.

The translaryngeal block is not performed in young children. Instead, just prior to insertion of the bronchoscope (or endotracheal tube prior to bronchography) a local anesthetic, such as tetracaine or hexylcaine, is sprayed or instilled into the trachea under direct vision.

ANESTHESIA TECHNIQUE FOR BRONCHOGRAPHY IN PATIENTS UPWARD OF AGE 10

In patients upward of age 10 the first seven steps listed under the technique for bronchoscopy are duplicated. When the patient's respiration ceases (after injection of succinylcholine), instead of a bronchoscope, an appropriate size endotracheal tube is inserted and connected to an elbow, as illustrated in the Figure. This elbow has a screw cap which is removable. (In the Figure the screw cap can be seen adhesived to the patient's chin.) Through this opening a narrow rubber or polyethylene catheter is inserted and guided into the right or left main bronchus with the aid of the fluoroscope. When the catheter is positioned properly, the radiopaque solution† (Propyliodone; Dionosil) is then injected through it into the desired lung.

The removal of this screw cap and the insertion of the catheter through the endotracheal tube will not interfere with the anesthesia plane because of the ingress of room air.

†An aqueous suspension of the *n*-propyl ester of 3, 5-diiodo-4-pyridone-N-acetic acid with the addition of sodium carboxymethylcellulose.

The high flow of gases is sufficiently turbulent to exclude room air at this screw-cap junction, and patients will remain anesthetized despite the opening in the system. The use of a narrow-bore instillation catheter does not seem to restrict nor cause labored respiratory effort despite the fact that 25% of the endotracheal tube is occupied by the catheter. The patient breathes very efficiently around this catheter.

ANESTHESIA TECHNIQUE FOR BRONCHOGRAPHY IN PATIENTS UNDER AGE 10

Children under age 10 are managed in the same manner as those for bronchoscopy except that an endotracheal tube is inserted instead of a bronchoscope. All other steps are identical.

COMMENT

This method of anesthesia is simple to administer and highly predictable in outcome. Because of the light anesthesia plane which is maintained without the portent of sudden anesthesia depth, it is reassuring to both the bronchoscopist and anesthesiologist, since the procedures described are usually performed in a dark room, where the signs of anesthesia depth are difficult to ascertain.

Because of the presence of an abundance of nitrous oxide in the mixture of gases, it is considered safer and less explosive to insufflate than anesthetic mixtures which contain ether.[2]

SUMMARY

A new method of general anesthesia for bronchoscopy and bronchography is presented in detail. The advantages of this method over other types of general and local analgesia are discussed.

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THE TRANSVERSE OSTEOTOMY: A NEW RHINOPLASTIC TECHNIQUE

G. HOWARD GOTTSCHALK, M.D., Los Angeles

The classical rhinoplasty operation as described by Joseph has been subject to many modifications in the past few years. New procedures and instruments have been introduced which have improved our handling of the cartilaginous portions of the nose. However, no satisfactory technique has as yet been described for narrowing the bony framework without the ever-present danger of comminuting or splintering the nasal bones.

A study of the anatomy of the uppermost portion of the nasal skeleton will reveal the inadequacy of our present-day technique. In this region the nasal bone and frontal process of the maxilla attach to the pars nasalis of the frontal bone and are supported on their underneath surfaces by the thick frontal spine, forming one solid plate of bone. This thick plate of bone forms the anterior, or ventral, portion of the nasal skeleton. The thickness of the nasal bones diminishes posteriorly, so that they are comparatively much thinner where they attach to the maxilla. Also, the bones are heavier at their attachment to the frontal bone than at their most inferior margins. Therefore, when the dorsum is narrowed by haphazard fracture of their superior attachment, the bones will break most easily through the thinnest areas, leaving the thicker anterior and superior portions still attached to the frontal bone.

Attempts have been made in the past to solve this problem. One accepted procedure is to introduce a narrow chisel through skin incisions over the base of the nose and thus fracture the bones. However, this usually results in visible scars. Another method is to use a curved chisel introduced beneath the skin. This may give a satisfactory result, but is likely to cause fragmentation of the bones. Other surgeons have suggested either angling the vertical osteotomy ventrally in the region between the eyes, so that there is a more narrow base to fracture, or fracturing the nasal bones at a level inferior to the inner canthus where the bones are much thinner. Either of these procedures will give a fairly clean transverse fracture, but both sacrifice something to be successful.

I am introducing a new step in the rhinoplastic technique which will enable the surgeon to completely mobilize the bony dorsum of the nose and to narrow the entire nasal skeleton without danger of fragmenting the bones or of leaving small spicules attached to the frontal process.

Fig. 1.—Transverse osteotomy saw (V. Mueller & Co., Chicago).

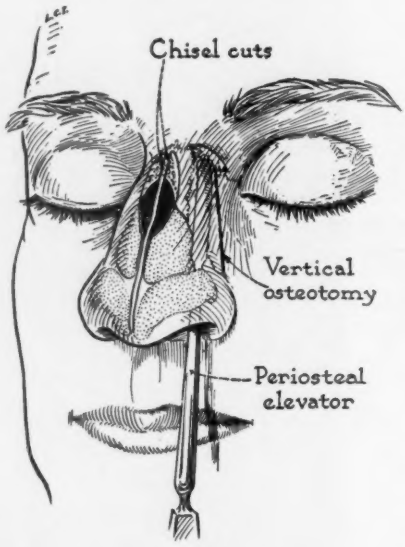

Fig. 2.—Elevating the periosteum and soft tissues before making transverse osteotomy.

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From the Department of Otolaryngology of the College of Medical Evangelists.

Presented before the Otolaryngology Section of the Los Angeles County Society of Ophthalmology and Otolaryngology, Feb. 28, 1954.

TRANSVERSE OSTEOTOMY

In order to get uniformly good results in every case no matter how thick the nasal bones may be, a transverse cut must be made through their bases at a high level, preferably superior to the inner canthus. These cuts may be made easily and with complete safety without damaging the overlying skin by using a transverse osteotomy saw (Fig. 1).

TECHNIQUE

The nose is anesthetized, and the skin elevated from the dorsum. The transfixion incision is made and the rhinoplastic operation is performed in the usual manner up to and including the vertical osteotomy saw cuts. These cuts must be made through the nasal process of the maxilla on each side as close to the face of the maxilla as is possible, and must extend superiorly to the frontal bone. The nasal bones are then separated from each other at their ventral attachments with a chisel up to the frontal bone. Care is taken not to fracture the nasal bones at this stage. Now, through the intercartilaginous incision, on each side a periosteal elevator is introduced and the periosteum and soft tissues are scraped from the surface of each nasal bone where the transverse saw cut is to be made (Fig. 2). Then the transverse osteotomy saw is introduced through the same intercartilaginous incision, and by using a semirotary motion, guiding

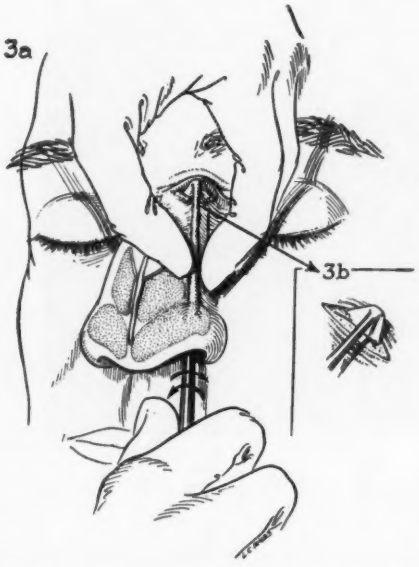

Fig. 3.—(*a*) Saw beneath the skin cutting through the superior attachment of the nasal bone on the left. (*b*) Detail showing saw cutting through the bone.

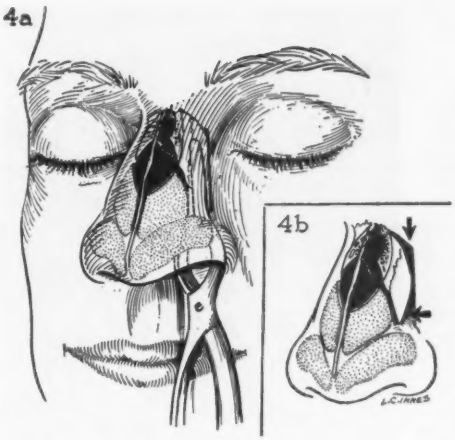

Fig. 4.—(*a*) Outfracturing the nasal bone on the left after the transverse osteotomy has been made. (*b*) Method of reducing glabellar angle.

the head of the saw with one hand, the bone is carefully cut. This step should not be hurried and may take three or four minutes on each side. It is not necessary to saw completely through the bone, but the cut should be made to a depth of several millimeters (Fig. 3). A Walsham or Asch forceps can now grasp the nasal bone, and with a very gentle twisting motion the entire bone is easily outfractured intact (Fig. 4*a*). If the glabellar angle is high, then the upper end of the bone is also tilted posteriorly somewhat, to reduce the angle (Fig. 4*b*). There is no danger of the bone falling into the nasal cavity because it is still attached to the mucosa on its inner surface.

I have now used this saw on 25 successive cases, without any complications or untoward reactions. Its use has removed my fear of the thick-boned post-traumatic nose.

As with any new procedure, some experience must be gained before uniformly good results can be expected. The following suggestions will be of help.

1. Do not make the transverse osteotomy until after the nasal bones have been separated in the midline and the vertical osteotomy has been completed, or the nasal bones may fracture.

2. Do not suture the columella to the septum until after completing the transverse osteotomy, so as to allow enough room for easy introduction of the saw.

3. Use only moderate pressure with the left hand in guiding the head of the saw to avoid trauma to the overlying skin.

4. The motion of the saw should not be a uniform back-and-forth motion. Instead, when cutting through the anterior portion, more pressure is

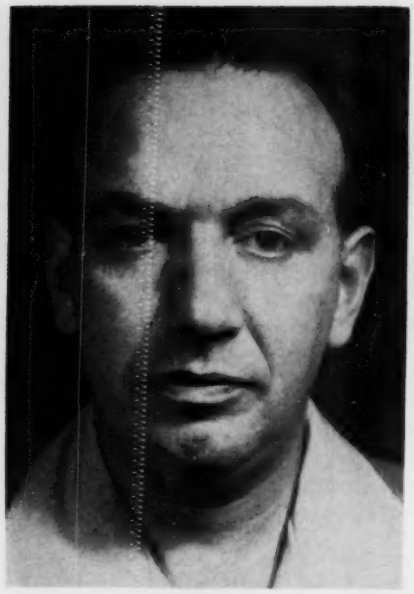

FIG. 5

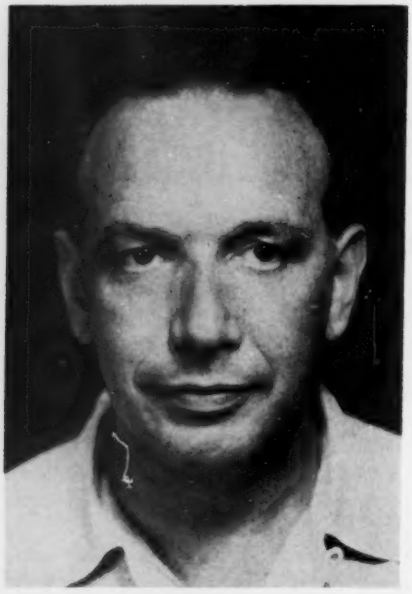

FIG. 6

FIG. 7

FIG. 8

Figs. 5, 6, 7, and 8 (Case 1 [J. S.]).—Heavy-boned, post-traumatic nose, with broad dorsum narrowed by using the transverse osteotomy technique.

exerted as the saw is rotated downward and laterally than on the up stroke. When cutting through the posterior portion of the bone, near the eye, exert more pressure on the up stroke than on the down stroke.

5. After the saw cut has been made, grasp the bone with a Walsham or Asch forceps and gently twist outward. If the nasal bone cannot be moved easily, then the transverse osteotomy was not deep enough and should be deepened.

FIG. 9

FIG. 10

FIG. 11

FIG. 12

Figs. 9, 10, 11, and 12 (Case 2 [D. N.]).—Congenital broad nose, with asymmetrical hump corrected by using the transverse osteotomy technique.

SUMMARY

The present technique of narrowing the nasal dorsum often results in fragmentation and splintering of the nasal bones.

A transverse osteotomy across the superior attachment of the nasal bones at or near the nasofrontal suture will completely mobilize the nasal bones and allow for a perfect fracture in every case, regardless of the thickness of the bones.

The technique of the transverse osteotomy is described in detail.

A MODIFICATION OF THE ENDAURAL INCISION

A Technique Which Provides a Pedicle Skin Graft for the Lining of the Mastoid Cavity in Surgery of the Temporal Bone

DAVID MYERS, M.D.
and
HAROLD WILF, M.D., Philadelphia

The purpose of this report is to describe a modification of the endaural incision originally described by Lempert.* In our hands, this has helped to prevent postoperative atresia of the external meatus, and it has provided a pedicle flap or graft that covers a good part of the newly created mastoid cavity and thus results in rapid epithelization and postoperative healing.

It has been our observation, and that of others (Whitaker and associates[4]), that the contracture which closes the newly created external meatus occurs at the inferior-posterior portion, rather than at the superior portion of the canal. It is in the inferior part of the canal over the broad remnants of the facial ridge (lowered posterior canal wall) that a dense bed of granulation tissue forms. When this area finally heals and contracts, a broad bed of scar tissue is present, which frequently produces narrowing of the canal when it contracts (Figs. 1, 2, and 3).

Ever since radical mastoid cavities have been created, methods have been sought to maintain the patency of the newly created meatus and to epitheliate the newly created cavity more rapidly. Various types of skin flaps have been cut from the remnants of the epithelial lining of the external auditory meatus and from the postauricular region. These have been described by Mosher,[5] House,[6] and Kahn.[7] In order to hasten epithelization, all types of grafts have been applied, which include pinch grafts, full-thickness grafts, split grafts, and pedicle grafts. However, it remains controversial as to whether these free grafts remain viable and actually seed themselves on the bare mastoid bone. This has resulted in modifications, such as that of Guilford,[8] which suggests the application of grafts after a period of several weeks, when the bone is covered with a layer of granulation tissue. In this procedure, a greater percentage of takes can be anticipated.

The procedure to be described may be somewhat similar or is possibly a variant of the procedures described by Tolan,† Work,[9] Whitaker, Juers, and Shambaugh,[4] and Maxwell.[10] Our technique pro-

† In discussion of House.[6]

Fig. 1.—F. B. six weeks after fenestration. Note dense bed of granulation tissue along remnants of posterior canal wall.

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Department of Otorhinology, Temple University School of Medicine, and Department of Otorhinology ENT Service No. 1, Albert Einstein Medical Center, Southern Division.

* References 1 to 3.

Fig. 2.—J. R. six months after fenestration: marked atresia external auditory meatus.

Fig. 3.—E. W. six months after fenestration: narrowed meatus. Note dense scar tissue at site of granulation tissue.

vides a large area of skin from the cavum conchae with a broad base pedicle which helps to insure its survival. When this is applied over the lower posterior canal wall and the tip of the mastoid, a primary take is almost assured. This area of new skin, plus the tympanomeatal flap of Lempert, that is used in the modern tympanomastoidectomy and/or fenestration operation, provides enough healthy skin with good circulation to cover more than two-thirds of the mastoid cavity. A primary take is anticipated because of the good circulation. When this occurs, only a very small area of the newly created mastoid cavity remains to be covered with granulation tissue and to epitheliate.

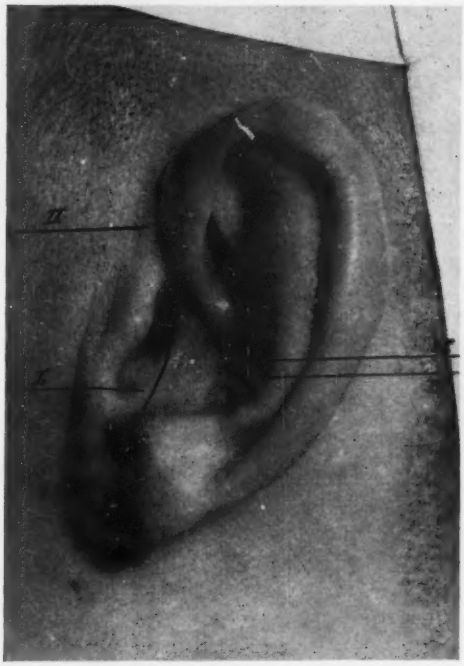

Fig. 4.—Outline of the incisions: *I*, first incision; *II*, second incision; *III*, third incision; *IV*, point at which conchal cartilage stands away from the mastoid surface.

An important factor recently emphasized by Senturia [11] indicates that these two areas of skin, namely, the tympanomeatal flap and the conchal flap, have an acquired immunity to the bacteria that have inhabited the previously infected cavity of the chronic discharging ear. In the fenestration operation, again, the tympanomeatal skin and the conchal skin are resistant to the normal bacterial flora of the ear. Therefore, immunity is present, and the healing is more rapid. It is evident that in a newly created mastoid cavity resistance must be acquired to the bacteria of the adjacent skin. In addition,

Fig. 5.—Dissection of cartilage and subcutaneous tissue from undersurface of pedicle flap.

Fig. 6.—Completed pedicle flap.

Fig. 7.—Mrs. W.: well-healed modified radical mastoid cavity. Note wide meatus.

Fig. 8.—Mrs. H.: well-healed fenestration cavity. Note wide meatus.

Fig. 9.—Mrs. W.: well-healed radical mastoid cavity. Note wide meatus.

grafts transplanted from a distance are of a different type of skin, which does not contain the same type of sebaceous and ceruminous glands. These distant grafts have no acquired resistance to the bacteria that inhabit the auditory area. The above-mentioned facts, plus the broad area of bone that must be covered with granulation tissue, result in a protracted period of healing and suppuration. The patient, after a modified radical mastoidectomy, a complete tympanomastoidectomy, or a fenestration, requires a great deal of time-consuming care. There is often continued suppuration, and there are broad areas of granulation tissue which require constant curettage and treatment. Healing is long and drawn out.

Since we have been using this new flap, in these procedures we have found healing to be amazingly rapid. Within a period of three or four weeks the cavity is almost completely healed, discharge is scant, and postoperative atresia has not occurred. The technique of this pedicle flap proceeds as follows (Figs. 4, 5, and 6): Incisions I and II are similar to the incisions of Lempert. Incision I begins at the outer third of the posterior-superior canal wall. This incision is continued downward and externally to the lowermost portion of the conchal cartilage. Incision II begins at the upper portion of Incision I, and is carried externally through Lempert's membranous triangle, avoiding the temporalis muscle, and then parallels the border of the helix. Incision III begins at the helix and is continued downward and posteriorly to include the entire cavum conchae and its underlying cartilage. The incision should be made shallow in the lowermost portion to avoid buttonholing the portion of the concha which extends away from the mastoid cortex. A broad base for attachment of the skin pedicle is left intact at the inferior aspect of the cavum conchae. The skin is freed from the underlying cartilage and dense soft tissue down to the mastoid cortex. The cartilage and soft tissue are removed, leaving a wide, long pedicle skin flap, which is tucked under the mastoid retractor until the procedure on the temporal bone is completed.

At the end of the operation after the tympanomeatal flap has been placed and secured, this triangular conchal pedicle flap is placed over the lowered posterior canal wall. The flap is mobilized so that it points somewhat posteriorly. It is held in place by a large piece of paraffin mesh gauze and petrolatum packing. The packing is removed on the fifth to the seventh day. In our experience, we have had a primary take of this skin in all our patients. Figures 7, 8, and 9 show the postoperative end-result and the ultimate shape of the newly created external auditory meatus.

SUMMARY

A modification of the endaural incision is presented which provides a pedicle flap for lining the mastoid cavity after surgery of the temporal bone. This flap also helps to prevent postoperative atresia of the external auditory canal by creating an especially wide external auditory meatus. The pedicle skin graft aids in more rapid healing of the mastoid cavity. A primary take of the flap on bare bone occurs because of the good blood supply.

304 S. 19th St.

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THE ANTIHISTAMINES IN LATE SECONDARY HEMORRHAGE

JOSEPH J. LITTELL, M.D., Santa Rosa, Calif.

Bleeding which occurs from the 3rd to the 14th day after an operation has always been a source not only of great annoyance and worry to me but also something of a mystery. Bleeding at this time is usually from a capillary bed rather than from a big vessel, has a strong tendency to recurrence over several days' time, and is difficult to control. One cannot pick up a bleeding point with a hemostat and tie it off. Caustics are sometimes helpful. Pressure on the area, especially with epinephrine, controls it as long as the epinephrine is effective and/or the pressure is maintained. But, as in the nose or the adenoid region, it is easy for a packing to slip a little or not be on the exact spot. In that case, one can expect an exasperating call to the effect that the area is bleeding again. After the 14th day, in my experience, the tendency to bleed ceases.

It has seemed that the difficulty in these cases was not any intrinsic failure of the blood-forming mechanism but, rather, was due to the persistent dilatation of blood vessels, which pathologically did not clamp down and remain so to control the flow of blood, or to transudation through the capillary walls. Laboratory studies in these cases reveal no obvious reason for this misbehavior. The coagulation time, bleeding time, prothrombin time, and platelet count are all normal. Yet the person continues to bleed persistently or recurrently until he is in some cases down to the transfusion level.

Over the years I have observed, particularly in the nose, that in these hemorrhage cases the intranasal tissue resembles the picture seen in vasomotor rhinitis. The turbinates are turgescent and puffy and, if very carefully observed, often pulsate with each heart beat. This tissue gives the impression of a vasomotor paralysis in which the distention of the terminal vessels is extreme. I have seen cases at this time—and it is usually about the fifth postoperative day—in which I was able to predict the onset of this type of bleeding because of the intranasal picture. Late tonsil or adenoid bleeding (and perhaps bleeding from any other part of the body) seems to be on the same basis, but these areas are not subject to critical examination because these puffy-type swellings could not be so well observed as in the fixed bony box of the nose, where encroachment on the air space was more obvious.

I had a case of this kind in August, 1954—a patient on whom I had done a submucous resection, sphenoethmoidectomy, and subturbinal resection of the anterior portion of a lower turbinate body. Bleeding began on the fifth day from several raw surfaces, accompanied by the above-described vasomotor swelling. I instituted an antihistaminic regimen, with 10 mg. of chlorpheniramine (Chlor-Trimeton) by hypodermic injection and 8 mg. of the delayed-action chlorpheniramine twice a day. The intense congestion in the nose was promptly reduced; the bleeding was checked and, except for the discharge of a little bloody mucus, did not recur. This pattern was so unusual to me that I felt heartened to try it again in my next case—a late tonsil bleeder, with similar result. Since that time all of my nose and throat surgical cases receive the equivalent of the adult dosage of 8 mg. delayed-action chlorpheniramine twice a day by mouth for a period of 10 days after operation. I have not been annoyed by any late bleeders since the institution of this routine.*

It is my distinct impression that the use of antihistamine at the time of surgery and immediately

Submitted for publication May 2, 1955.

* Since the article was written, and as of Sept. 10, 1955, I have seen three cases of postoperative bleeding which required an unilateral anterior nasal pack. One was an apparently eroded spurting vessel in the incisor canal, injured when its bony surroundings were chiseled away during a submucous resection. The antihistamines could not be expected to control this. Case 2 was from a submucous resection of a lower turbinate in a profoundly allergic boy in whom the antihistamines were ineffective in reducing a tremendous vasomotor swelling. The third case showed persistent oozing from the tip of an injured middle turbinate in a man with a blood pressure of 210/114.

thereafter tends to minimize postoperative tissue swelling along with immediate bleeding associated with it, with a consequent amelioration of the patient's discomfort. This is noticeable in procedures done under local anesthesia, such as intranasal surgery and rhinoplasty, as well as those performed under general anesthesia.

These observations are made from a clinical standpoint only. They might be based on coincidence and the conclusions premature. The virtue of a report of this kind is, however, that it will stimulate similar observations by others. Time and further experience will or will not support my present belief that late bleeding is produced by a pathologic vasomotor dilation or transudation due to infection or local tissue shock, so to speak, with a disturbance of the vasomotor mechanism of the area. Elaboration of histamine in the tissues may be a factor. If the above is true in the field of rhinology, the same principles should apply to late bleeding elsewhere in the body and use of the antihistamines for emergencies as well as prophylactically would be productive of much benefit.†

SUMMARY

Postoperative bleeding of a persistent recurrent nature occasionally occurs between the 3rd and the 14th postoperative day and usually around the 5th. It is associated, in my experience, with a tissue turgescence similar to that seen in vasomotor rhinitis. Its occurrence seems to be favorably influenced therapeutically and prophylactically by the oral or hypodermic use of antihistamines. Further observation by others is suggested in a wider series of cases in this as well as other specialties.

435 Humboldt St.

† A controlled study of this matter is in progress at the Sonoma County Hospital. The chlorpheniramine is furnished through the courtesy of Dr. Babcock, Research Department, Schering Company.

Abstracts from Current Literature

Ear

CORRECTION OF CONGENITAL ANOMALIES OF THE EAR. EUGENE L. DERLACKI and GEORGE E. SHAMBAUGH JR., Illinois M. J. **105**:107 (March) 1954.

Since the particular anomaly in each case varies considerably and no one technique can be suitable for all cases, the authors of this article believe that in each case the surgical procedure should be fitted to the condition that is found, keeping in mind that the aim is to construct a sound conductive system that will most nearly approach the normal impedance-matching mechanism. There is a marked tendency for anomalies of the inner ear to be independent of anomalies of the outer and middle ear. Of the 24 operations completed for improvement of the hearing in this study by the authors, all received an initial hearing gain. In three the gain was not maintained. Of the 21 ears with maintained improvement in hearing, 13 are at the practical 30 db. level or better at the most recent test.

BARBOUR, Peoria, Ill. [A. M. A. AM. J. DIS. CHILD.].

DIAGNOSIS AND TREATMENT OF SECRETORY OTITIS MEDIA. PIERCE W. THEOBALD, Illinois M. J. **105**:313 (June) 1954.

Secretory otitis media is being encountered more frequently and being diagnosed more frequently than previously. Etiology of the disease is blockage of the Eustachian tubes due to infection, allergy, or mechanical factors. Secretory otitis media may cause a considerable hearing loss, but if proper treatment is instituted the loss is a reversible one.

The diagnosis is made from the history, the appearance of the tympanic membrane, inflation and auscultation of the middle ear, and diagnostic myringotomy if necessary. Although conservative therapy may often be of value in children, it rarely is so in adults. Secretory otitis media in children is usually an indication for tonsillectomy and adenoidectomy.

Prognostication is difficult, for often there is no relationship between duration of symptoms and time required to effect a cure.

THE CONDITIONED GALVANIC SKIN RESPONSE UNDER TWO MODES OF REINFORCEMENT. CLAY MERITSER and LEO DOERFLER, J. Speech & Hearing Disorders **19**:350 (Sept.) 1954.

The galvanic skin response in 56 subjects with normal hearing for 1000 cps was conditioned to appear upon auditory stimulus using electric shock as the unconditioned stimulus. One-half of the group received 40% reinforcement with the unconditioned stimulus; the other half received 100% reinforcement. Half of each subgroup was conditioned with a constant test of 30 db.; the other half was conditioned with a variable intensity of 30, 50, and 70 db. Reinforcement was then discontinued. One-half of each subgroup was extinguished at a constant intensity of 30 db.; the other half was extinguished at variable intensity. The 40% reinforced group showed greater resistance to extinction.

PALMER, Wichita, Kan. [A. M. A. AM. J. DIS. CHILD.].

INTRACRANIAL COMPLICATIONS OF OTITIS MEDIA AND MASTOIDITIS IN THE ANTIBIOTIC ERA: MODIFICATION OF THE PATHOLOGY OF OTITIC INTRACRANIAL LESIONS BY ANTIBIOTIC PREPARATIONS. CYRIL B. COURVILLE, Laryngoscope **65**:31 (Feb.) 1955.

Intracranial complications of otitis media have decreased greatly since the advent of the sulfonamides and antibiotics. Previously, in 25 of every 1000 autopsies the cause of death was a complication of otitis media, while now there are 25 in 10,000 autopsies, 1/10 as many. Meningitis, as before, is still by far the commonest complication. It occurs especially in a dehydrated and malnourished infant. Lateral sinus thrombosis, formerly fairly common, has practically been eliminated, as have also the "distant" brain abscesses (i. e., brain abscesses away from the source of infection, caused by venous extension of the disease). "Adjacent" brain abscesses still occasionally occur. Some aerobic organisms may cause a widespread invasion of the brain, the so-

called "diffuse" brain abscess. Inadequate treatment or antibiotic-resistant organisms largely account for these complications.

The article is illustrated with pictures of gross specimens of the brain showing various involvements.

HITSCHLER, Philadelphia.

INTRACRANIAL COMPLICATIONS OF OTITIS MEDIA AS MODIFIED BY SULFA DRUGS AND ANTIBIOTICS: CLINICAL ASPECTS. J. M. NIELSON, Laryngoscope **65**:47 (Feb.) 1955.

The various otitic complications of the preantibiotic era are described separately and in some detail. The extreme care necessary in making a proper diagnosis and evaluation of the condition is noted. This is contrasted to the tendency nowadays to rely entirely upon the antibiotics without proper study of the case. Thus the important early signs and symptoms are frequently missed. A brain abscess may be near the rupturing point without recognition.

HITSCHLER, Philadelphia.

SURGICAL APPROACH FOR SO-CALLED GLOMUS JUGULARE TUMORS OF THE MIDDLE EAR. GEORGE E. SHAMBAUGH JR., Laryngoscope **65**:185 (April) 1955.

Glomus jugulare tumors have the following characteristics: (1) They occur in the tympanic cavity; they often arise from the hypotympanum but sometimes directly from the dome of the jugular bulb. (2) They occur mostly in young and middle-aged adults. (3) They are slow growing but invasive and may be malignant and even metastasize. (4) Pulsating tinnitus and conductive hearing loss are the early symptoms. Otorrhea may follow. Instrumentation causes profuse bleeding. (5) Other symptoms follow as the tumor invades vital structures. (6) On examination one sees a sharply defined reddened or bluish mass in the tympanic cavity, behind the eardrum. Later the tumor will be seen protruding through the drum. X-ray examination is not particularly helpful but biopsy is. (7) There may be a pulsation seen when increased air pressure is applied.

Surgical removal is the treatment recommended; if the tumor is fairly extensive a radical mastoidectomy is necessary to expose the tumor. Sometimes the jugular vein and external carotid artery have to be ligated first. For smaller tumors, Shambaugh describes a new approach called hypotympanotomy. Details of this procedure are given.

HITSCHLER, Philadelphia.

RESTORATION OF HEARING IN OTOSCLEROSIS BY MOBILIZATION OF THE FIXED STAPEDIAL FOOTPLATE: AN ANALYSIS OF RESULTS. SAMUEL ROSEN, Laryngoscope **65**:224 (April) 1955.

By mobilization of the stapes in otosclerosis improved hearing should result. It is possible to regain normal hearing provided the hearing nerve is normal.

Under local anesthesia, the posterior canal wall is incised from 9 to 3 o'clock. It is then carefully dissected down to the eardrum. The drum is then freed and, together with the loosened canal, folded back. Thus the middle-ear cavity is exposed. Using a special instrument, pressure is applied to the neck of the stapes in the direction of the tendon of the stapes. Mobilization may then occur, and hearing be restored. Cases are discussed and results shown. As with the fenestration operation, the better the bone conduction and the greater the spread between bone conduction and air conduction, the better the result.

In the most favorable group of cases 52% achieved satisfactory hearing, in the next group 32%, and in the poorer group 26%.

HITSCHLER, Philadelphia.

PRESCHOOL DETECTION OF DEAFNESS BY DOCTORS AND PARENTS: ITS IMPORTANCE IN PREVENTION, RESTORATION AND REHABILITATION. EDMUND PRINCE FOWLER SR., New York J. Med. **55**:797 (March 15) 1955.

This paper was one of a series of "lectures" on various subjects given by various authorities before the Annual Meeting of the New York State Medical Society during May, 1954. Fowler recalls the fact that deafness is reportable under the state laws, but that few seem to know or obey this law. The statute is "loosely drawn and has no teeth." Detection of early deafness is the responsibility of those nearest the child: mother, nurse, physician, and teacher. If a child playing on the floor takes no notice of the sound of fire engines, automobile horns, or noises in the home or shows no "startle reflex," he is suspect, and one must search for the lack of

response. The baby should be tested surreptitiously or while out of sight of the noise source. While playing a game with the child, the mother may notice no or an inadequate response. The physician should have a history of affected siblings, or so-called "family deafness," having in mind a predisposition to heredity. Total deafness never recovers, and to look for a "miracle cure" is expensive, ridiculous, and nonproductive. One had better place the child in a part-time nursery school for the deaf, then graduate him to a resident school where lipreading and other methods are in use. The infectious diseases of childhood often leave a hearing loss, which should be determined by an otologist. It then becomes his duty to check such loss and to give treatments according to his judgment. There is "a large factor of chronicity" always present, and therefore early detection is paramount.

I. W. VOORHEES, New York.

CONGENITAL DEAFNESS. A. A. J. VAN EGMOND, J. Laryng. & Otol. **68**:429 (July) 1954.

Congenital deafness is defined and classified and the distinction between acquired congenital deafness and inherited congenital deafness attempted. The influence of environmental, chemical, and physical factors must be known and borne in mind in addition to straight Mendelian concepts. Indeed, these environmental factors lend more promise from the standpoint of prevention (i. e., rubella deafness) than is offered in inherited congenital deafness where sterilization and social restrictions are the only weapons.

There are two types of congenital hereditary deafness, namely, dominant hereditary and recessive sporadic deafness. The former is rarely congenital, usually develops at middle age; it shows a strong tendency to progression for all pregnancies and according to its dominance will be present in every generation, with a chance of 50% of the offsprings.

Congenital sporadic recessive deafness may be combined with other disorders, such as disturbed vestibular function, retinitis pigmentosa, feeble mindedness, and hereditary ataxia, and is commonly the product of consanguineous marriages (i. e., 7% of all deaf-mute children). Congenital hereditary deafness accounts for half to one-third of all the deaf, recessive deafness strongly predominating. In both types there is a lack of histopathological consistency of the structures involved. In general, in sporadic recessive deafness the cochlear bone is intact and there is a deficiency of the total acoustic nervous system. In dominant hereditary deafness the development of the cochlear bone is arrested with secondary defects of the nervous structures. In both, the organ of Corti is more or less damaged, and this explains the varying degrees of hearing loss encountered.

The deafness associated with congenital atresia of the external meatus, erythroblastosis fetalis, environmental factors (i. e., rubella), syphilis, and drugs such as quinine, the salicylates, and alcohol is discussed.

The prevention of congenital deafness is primarily a social, hygienic, and nutritional problem.

LE JEUNE and NORMANN, New Orleans.

A NOTE ON THE HISTO-PATHOLOGY OF MÉNIÈRE'S DISEASE. J. C. SEYMOUR, J. Laryng. & Otol. **68**:730 (Nov.) 1954.

The etiology of Ménière's disease remains an unsolved problem. The presence of subepithelial vesicles on the walls of the semicircular canals is believed by the author, Hallpike, and others to be of no pathological significance. Lempert, on the other hand, can explain all the symptoms of Ménière's disease on the basis of these vesicles. The consistency with which these vesicles are found both in normal and pathological specimens seems to confirm their insignificance. The improbabilities that a hypothetical toxin actually exists are also discussed. Furthermore, rupture of these vesicles has never been seen in the author's material, although Lempert does report this. The possible significance of the presence of an albuminoid coagulum in both the perilymph and endolymph is mentioned.

The evidence favoring a vascular etiology in Ménière's disease is increasing.

LEJEUNE and NORMANN, New Orleans.

DIFFICULTY IN CONDITIONING GALVANIC SKIN RESPONSES: ITS POSSIBLE SIGNIFICANCE IN CLINICAL AUDIOMETRY. R. GOLDSTEIN, H. LUDWIG, and R. F. NAUNTON, Acta otolaryng. **44**:67 (Jan.-Feb.) 1954.

The hearing of 4 children from two schools for the deaf was tested with conditioned galvanic skin reflexes. One group of children was conditioned easily, the other with difficulty. In many of

the situations where the conditioning was difficult, previous diagnoses suggested the presence of aphasia; conversely, in most of the cases in which conditioning was easily accomplished, no aphasia was found. Five adults were also tested in instances where psychogenic deafness or long-term malingering was present. This group as well was conditioned, only with difficulty.

The results seem to indicate that in accomplishing threshold audiometry using the skin response as an indication of hearing the very cases in which present techniques are inadequate are not successful here. Audiograms obtained in that group in which conditioning was difficult by the conditioned reflex method were misleading, for the PGSR response always suggested poorer hearing than indicated by conventional tests. The relation that exists between difficult conditioning and already diagnosed aphasia shows that the PGSR test may act to confirm a clinical diagnosis of a communication disorder other than peripheral deafness. LEWY, Chicago.

CLINICAL OBSERVATIONS ON THE EVACUATING FUNCTION OF THE HUMAN EUSTACHIAN TUBE. M. FUKAMACHI, J. Oto-Rhino-Laryng. Soc. Japan **57**:57 (Nov.) 1954.

To study the ability of Eustachian tube to evacuate the contents of the middle ear, Fukamachi introduced a measured quantity of a 1% solution of Indigo Carmine into 94 tympanic cavities through the eardrums. He observed the tubal orifice through a nasopharyngoscope as the dye passed through it.

In healthy subjects the dye appeared in 10 to 15 minutes and lasted one hour or less. He noted that the gross evacuation occurred by contraction of the tubal musculature and that the finer elimination was accomplished by the ciliary motions. In the presence of chronic tubal obstruction of organic origin, the gross elimination began as in the healthy subjects but the dye continued to flow much longer. In chronic obstructions of a functional nature, the gross elimination was greatly prolonged.

During the acute tubal inflammation, the elimination was completely suspended and resumed its function in 7 to 10 days when the inflammation subsided. The author considers that the tensor palatine muscle plays a much greater part in the elimination of the dye than the levator palatine muscle.

HARA, Los Angeles.

A CLINICAL INVESTIGATION OF MÉNIÈRE'S DISEASE AS AN ANGIONEUROSIS. I. WATANABE, Otolaryngology (Tokyo) **58**:15 (April) 1955.

Watanabe records his study on 40 cases of Ménière's syndrome with recurrent attacks of various symptoms. Forty per cent of these patients had complications or histories of angioneurosis or allergic manifestations in the other part of the body. In 15% of the cases there were evidences of autonomic imbalance.

Reactive hyperemia test in the finger plethysmogram was observed in five cases, and increased spastic tendency of the arterioles was found both in the intervals and, especially, before and during the attacks.

He was able to control frequent attacks by hypodermic injections of an antihistaminic drug (tetraethylammonium bromide). These observations led the author to believe that Ménière's syndrome is typical angioneurosis of the labyrinth.

HARA, Los Angeles.

ELECTROMYOGRAPHIC OBSERVATIONS ON THE VESTIBULOSPINAL REFLEX. Y. OGINO, J. Oto-Rhino-Laryng. Soc. Japan **58**:25 (May) 1955.

Ogino attepted to apply electromyography for investigating vestibulospinal reflexes. The reflexes were elicited with both caloric and rotatoric stimuli. The electromyographic pattern in the case of optic nystagmus was also observed for the comparison with rotation nystagmus.

With high-speed rotatoric, caloric, or optic stimuli, the extensors on the rotatoric, or stimulated, side were inhibited during the stimulation and the reversal occurred on the cessation of the stimuli. With slow-speed rotation, exactly opposite effects appeared.

Also, in the following investigations, the reverse effect was revealed on the electromyogram between the high and the low rotating speeds, viz., rotation with changing speed, rotation sustained in constant speed for a long duration; rotation with undulating speed, rotation left to stop spontaneously.

Relation between labyrinthine and optic muscle tonus: On the electronystagmographic and electromyographic records, the author observed that the optic effects were observed to be more effective than the vestibular ones in the sense that in concomitant application of optic and labyrinthine rotatoric stimuli the effect of the latter was masked by that of the former. On the other hand, the electromyographic change caused by optic stimulation was always the same, irrespective of strength of stimulus.

The author considered that the feeble rotatoric stimuli of the physiological level differ in reflex pattern from the nonphysiological strong rotatoric stimuli and the caloric stimuli, of which the latter are of physiologically inadequate quality. The domination of the optic stimulus over the labyrinthine one in determining the reflex effect should not be considered because it is one of the most natural ways of stimulation, but because different systems are involved in affecting muscular tonus between the optic spinal reflex and the vestibulospinal reflex.

HARA, Los Angeles.

Larynx

RECENT TRENDS IN THE MANAGEMENT OF ESOPHAGEAL STRICTURES. CLAUDE C. CODY III, Ann. Otol. Rhin. & Laryng. **63**:1120 (Dec.) 1954.

Cody advocates early esophgoscopy in patients who are suspected of having caustic esophageal burns. Esophagoscopy establishes whether the esophagus is involved or not and fixes the site of damage in those instances where burns have occurred. If evidence of esophageal burn is found, immediate daily dilatation with soft mercury-filled bougies is started. After approximately one month of dilatations have been carried out, a second esophagoscopy is done. Following this, periodic dilatations are performed at longer intervals.

The late burned cases with stricture can be classified as (*a*) short stricture, (*b*) long or multiple strictures, and (*c*) stricture responding poorly to prolonged dilatation. Cases with short esophageal stricture usually respond well to bouginage. Those with long or multiple strictures pose real problems. Gastrostomy is usually necessary so that retrograde dilatation can be carried out. For the cases in which the stricture responds poorly to prolonged dilatation, Cody frequently advises surgical resection, although it is believed firmly that if there is any means of establishing and maintaining the continuity of the esophagus without surgery a great advantage has been realized over any surgical correction.

STEELE, Kansas City, Kan.

PROGRESS IN THE TREATMENT OF CAUSTIC LESIONS OF THE ESOPHAGUS AND THEIR SEQUELAE. K. BURIAN, Wien. klin. Wchnschr. **67**:162 (March 4) 1955.

Immediate treatment with cortisone in caustic lesions of the esophagus proved eminently beneficial, shortening the time of recovery and preventing the formation of stenosis. So far only one child with a very severe lesion has been treated with corticotropin (ACTH), but stenosing could not be prevented.

AMBERG, Rochester, Minn. [A. M. A. AM. J. DIS. CHILD.].

BRONCHOGRAPHY WITH MIXTURES OF IODIZED OIL AND SULFADIAZINE. J. N. BOET, Nederl. tijdschr. geneesk. **98**:78, 1954.

Isoniazid oil (Lipiodol) has the disadvantage that it may remain for a long time in the alveoli. Radiological check-ups are made difficult in this way. Watery suspensions were too irritating. A more viscous fluid of mixtures of iodized oil and sulfadiazine has been proved useful. Within four hours most of the contrast medium has been expectorated. Forty-eight hours later the lungs are clear. Peripheral branches of the bronchial tree, however, do not fill adequately. In purulent bronchitis with bronchiectasis pure iodized oil is preferred, as this fills the small branches better. Twenty milliliters of iodized oil was mixed with 3 gm. of sulfadiazine. It is advisable to commence a bronchographic investigation with this mixture. If no adequate filling of the smaller bronchi is seen, another bronchogram should be made with ordinary iodized oil.

VAN CREVELD, Amsterdam [A. M. A. AM. J. DIS. CHILD.].

Nose

THE VENOUS NETWORKS OF THE NASAL MUCOSA. OSCAR V. BATSON, Ann. Otol. Rhin. & Laryng. **63**:571 (Sept.) 1954.

Batson reports studies on the veins of the human nose based on a series of corrosion preparations after injecting the venous network with methacrylate.

It is demonstrated that the nasal cavity is pervaded throughout by an interlacing venous network of vessels of from 0.1 to 0.5 mm., and larger, in internal diameter. These veins are a valveless network. They communicate everywhere with each other and with the veins of the underlying bone. The thickness of the venous network parallels the thickness of the mucous membrane itself. Even within the sinuses, with their thin mucosa, there is a rich venous network in a more or less collapsed state.

An extensive communication of the perisaccus vein of the nasolacrymal duct with the veins of the nasal mucosa may offer an explanation for the swollen appearance of the lacrymal sac area in young children during acute coryza.

The valveless continuity of the sinus venous network with that of the nasal cavity could account for the presence of fluid in the sinuses during acute coryza without actual infectious invasion of the sinus cavity. Early venous engorgement responsible for increased nasal secretion unquestionably produces sinus secretion.

The continuity of the submucosal and subcutaneous network of veins over the alar cartilages furnishes the anatomical basis for the red and swollen nasal tip characteristic of the early stages of acute coryza.

STEELE, Kansas City, Kan.

SCLEROMA IN EGYPT. GEORGE BOTROS, PAUL K. HAMILTON, THOMAS M. FLOYD, ALY MUFTI, and AHMED IMAM, Ann. Otol. Rhin. & Laryng. **63**:1031 (Dec.) 1954.

Botros and associates studied 14 cases of rhinoscleroma, of which 9 were females and 5 males, occurring in an age range of from 16 to 52 years. Cultures and biopsies were performed. A clinicopathological classification of the disease is proposed as follows: Stage 1, the early catarrhal stage; Stage 2, the atrophic stage; Stage 3, the granulomatous stage; Stage 4, the stage of fibrosis. The various stages merge into each other and overlap in the whole upper respiratory tract. Klebsiella rhinoscleromatis organisms were cultured from 3 of the 14 patients.

Patients with nasal involvement by rhinoscleroma responded better to antibiotics, while those showing laryngeal lesions seemed to show some resistance to therapy. Antibiotics were most effective in the first three clinicopathological stages of the disease. According to the authors, chlortetracycline (Aureomycin) seemed to be the most effective antibiotic, while streptomycin, though effective, required a longer course of treatment. Oxytetracycline (Terramycin) seemed effective when used in cases with nasal involvement but was disappointing if used for treatment on patients who showed distribution of the disease other than nasal. The action of streptomycin seemed to be enhanced when isonicotinic acid was also given.

STEELE, Kansas City, Kan.

LOCAL TREATMENT OF ALLERGIC RHINITIS WITH CORTOGEN AND CHLOR-TRIMETON MALEATE. WILLIAM H. EVANS, Eye, Ear, Nose & Throat Month. **34**:39 (Jan.) 1955.

Cortisone has been used locally in the nose both topically and by submucosal injections into the turbinates and by direct injection into the polyp. While commenting on the experience of others in this work, Evans describes three cases in which he injected cortisone directly into the polyp, with marked decrease in the size of the polyp. No reactions were observed in these cases, but two cases were described from a report of Wall and Shure in which two severe reactions were observed immediately after injection of cortisone into the turbinates. There was severe flushing of the skin, marked substernal pain, difficulty in breathing, abdominal distention, and severe backache. The patient became cold and clammy, the systolic blood pressure dropped to 80, but there was no loss of consciousness. Each patient recovered without treatment, and there were no after-effects. Semenov encountered a similar but less violent reaction in one of his patients, following similar treatment.

No local or general reactions were encountered with the topical use of cortisone. Evans has used both cortisone alone and a combination of cortisone with Chlor-Trimeton in a suspension. Chlor-Trimeton Maleate is a powerful antihistaminic exerting a strong local nasal constricting action, presumably through a change in capillary permeability. The mixture of cortisone and

Chlor-Trimeton is more effective than either agent alone. Three hundred patients have been treated with the combined suspension of cortisone and Chlor-Trimeton. This has been administered as drops or as packs or both. In those patients who have had various types of both local and systemic therapy prior to the use of this combination, the local administration of cortisone and Chlor-Trimeton gave more prompt and lasting relief than anything previously tried. In other patients this treatment was administered as adjuvant therapy.

A mixture of cortisone and Chlor-Trimeton is therefore a most effective agent in the control of allergic rhinitis. It is extremely valuable either as the only medication or as an additional medication in the control of severe symptoms in hay fever due to grass and ragweed pollens.

JENNES, Waterbury, Conn.

THE RHINOLOGIST AND THE ORBIT—SOME PERSONAL RECOLLECTIONS. V. F. LAMBERT, Proc. Roy. Soc. Med. **48**:79 (Feb.) 1955.

Professor Lambert is president of the Section of Laryngology. He held forth at the meeting on Nov. 5, 1954, on the subject of diseases of the orbit. The observation was made that more than two-thirds of the bony walls of the orbit are also the bony walls of the paranasal sinuses; therefore, infection readily spreads, especially if the bone is very thin or dehiscent. X-ray films are, therefore, of great importance. As for the globus, three factors are concerned: placement, mobility, and intraorbital swelling. In "our Department, the most common nasal condition to produce proptosis was mucocele of the frontal or ethmoidal air sinuses." Eight cases of orbital cellulitis were seen, and in all more than one sinus was affected with Staphylococcus or Streptococcus as invading organisms. But "the whole picture has been changed since the introduction of the sulpha drugs and the antibiotics." The optic nerve is tolerant of infections up to a certain point, but beyond that point the pathological condition is irreversible. Lambert believes that surgery in all such cases should be "minimal," especially in the acute ones. Drainage and the antibiotics may suffice, with radical surgery at a later date, if required. Malignant tumors of the orbit are not common and were seen in only 70 patients during a 23-year period. Proptosis and diplopia are seldom present during the course of postnasal tumors, and in 132 surveyed by Lambert, only 7 sought advice because of "eye trouble." Eighteen figures and five references are used to illustrate the author's thesis.

I. W. VOORHEES, New York.

DIAGNOSIS AND THERAPY OF CHRONIC MAXILLARY SINUSITIS OF CHILDREN. H. WISSLER, H. ISELIN, and A. RÄBER, Schweiz. med. Wchnschr. **84**:688 (June 19) 1954.

The study of the symptomatology of 75 cases of chronic maxillary sinusitis in children has been reported previously. The incidence is given as about 50% of all patients with recurring infections of the respiratory tract. In children with normal upper respiratory tracts it was found in about 1%. Chronic cough is the most frequent symptom. The association with chronic bronchitis and bronchiectasis is stressed. The best diagnostic procedure is x-ray of the sinus. About one-third of the patients responded with complete cure to regular washings combined with penicillin injections. When this treatment is ineffective, surgery is indicated.

AMBERG, Rochester, Minn. [A. M. A. AM. J. DIS. CHILD.].

Miscellaneous

SUBACUTE THYROIDITIS. FRANCIS H. MCGOVERN, Laryngoscope **65**:199 (April) 1955.

Subacute thyroiditis manifests itself as a mild painful swelling of the thyroid gland, sore throat, and dysphagia. There may be an initial febrile period. The white cell count is high and the sedimentation rate lengthened. The pulse rate is high. However, the basal metabolic rate is normal. The uptake of radioactive iodine is lowered. Other signs and symptoms of hypothyroidism are sometimes present.

The etiology of this condition is not known. It is not bacterial. Some think it is viral or a sensitivity reaction.

Treatment with cortisone and corticotropin (ACTH) is markedly successful. Twenty-five milligrams of cortisone a day may relieve the symptoms in 24 hours and reduce the glandular swelling. The treatment has to be continued longer, however, and should not be stopped until the sedimentation rate is normal. X-ray treatment also is useful and may give a more permanent result than cortisone therapy.

Emphasis is placed on the fact that otolaryngologists are apt to overlook the thyroid gland and that pain in this area can be interpreted by the patient as sore throat.

HITSCHLER, Philadelphia.

AEROSOL ADMINISTRATION OF ALEVAIRE: II. CLINICAL EVALUATION. ANDRE SMESSAERT, VINCENT J. COLLINS, and VINCENT D. KRACUM, New York J. Med. **55**:1587 (June 1) 1955.

Adequate elimination of secretions from the respiratory tract is an old problem in medicine. Any impairment of the cilia or peristaltic action of the bronchioles causes retention, and the cough reflex may be impaired because of drugs, anesthesia, pain, insufficiency of the respiratory muscles, tight binders, vocal cord paralyses, or tracheostomy. Also, changes in the quantity and quality of secretions, viscosity, and bronchospasm are disturbing factors. Alevaire inhaled as an aerosol mist can liquefy secretions. For this study, Triton WR-1339 was used with sodium bicarbonate, 2% and glycerin, 5%. The Winthrop-Stearns, Inc., provided the set-up. The equipment is illustrated in the body of the article. The rate and duration of administration are described, and five case reports are cited. In all 300 cases have been studied, and the work is continuing. "In cases where usual forms of therapy had failed, surface-active agents have given favorable results, especially in newborns and unconscious patients."

I. W. VOORHEES, New York

TREATMENT OF INFECTIOUS ASTHMA AND RESPIRATORY INFECTIONS WITH ACELLULAR BACTERIAL ANTIGEN COMPLEX. AARON D. SPIELMAN, New York J. Med. **55**:1603 (June 1) 1955.

Spielman reports his work in the allergy clinic of the Beekman-Downtown Hospital, New York. He says that the advisable use of the antibiotics has greatly detracted from the study of antigens and has prevented immune body production, thus making desensitization difficult. In the making of vaccines many desirable elements are lost; therefore a vaccine may be lacking in important antigenic components. Experimental work with Hoffman's acellular bacterial vaccine complex has proved its value because it does contain antigenic agents missing in many preparations. Results have been very good in about 80% of the cases. No undesirable side-effects have been noticed, and there has been no need for antibiotics. "Treatment with bacterial antigen complex preparations should be accompanied by simultaneous treatment of all non-bacterial allergies and attention to all medical needs of the patient." There are two illustrative detailed case reports, four tables, and 12 references to the literature.

I. W. VOORHEES, New York

RUPTURE OF ESOPHAGUS BY EMESIS. HERBERT C. MAIER, New York J. Med. **55**:1625 (June 1) 1955.

Maier says that rupture of the esophagus from sudden copious vomiting is "relatively uncommon." The onset is so violent that fatality will result unless early diagnosis and surgery are promptly instituted. Differential diagnosis lies among myocardial infarction and perforated peptic ulcer, in all of which one may find shock, dyspnea, and cyanosis. The history of a big meal followed by partial emesis, retching, and rigidity of the upper abdominal quadrant with epigastric pain must be carefully considered. Lung examination shows diminished breath sounds, usually on the left side, emphysema, hydrothorax, or hydropneumothorax. X-ray studies may clinch the diagnosis. A case of a 55-year-old man who had enjoyed a large meal with much beer is cited, with the surgical findings reported in detail. The pleural cavity was filled with stomach contents. This was completely removed, and both penicillin and streptomycin were instilled into the emptied cavity after suture of the esophageal tear. Postoperative sequence was normal, and the patient is still well after a two-year follow-up. The previous high mortality was probably due to delayed diagnosis or wrong diagnosis. Simple drainage is insufficient. The esophageal rent must be carefully closed, and the thoracotomy almost closed, allowing for seepage from the pleural sac. Lung expansion can be accomplished gradually according to the condition at hand.

ABSTRACTOR'S COMMENT: Nothing is said as to the value of esophagoscopy. It seems not to have been necessary in this instance.

I. W. VOORHEES, New York

THE PAST FIFTY YEARS IN THE MANAGEMENT OF SURGICAL INFECTIONS. F. L. MELENEY, Internat. Abst. Surg. **100**:1, 1955; in Surg., Gynec. & Obst., Jan., 1955.

The Golden Anniversay of *Surgery, Gynecology, and Obstetrics* is being celebrated this year. A series of Collective Reviews covering the development of surgery during the past 50 years begins with Dr. Meleney's stimulating summary of the management of surgical infections during this period. One reads with fascination the controversies and problems which attended the early attempts to avoid wound infections when appendicitis, puerperal fever, tetanus, generalized sepsis, and osteomyelitis were the chief concern of the surgeon.

The lessons learned in World War I, the emergence of the concept of postoperative pulmonary complications, and continued interest in infections characterized the second decade (1915-1924).

In the third decade of the publication's existence there began to appear laboratories of bacteriology in various surgical departments. The fourth 10-year period, from 1935-1944, saw the introduction of chemotherapy and antibiotics and the revolutionary changes in surgery which accompanied their use. The present status of the treatment of surgical infections is surveyed comprehensively. Any surgeon will find much of historical and educational value in this interesting review.

FRIEDBERG, Chicago.

ESOPHAGEAL HIATAL DIAPHRAGMATIC HERNIA. S. W. HARRINGTON, Surg., Gynec. & Obst. **100**:277 (March) 1955.

This report summarizes the author's experience with 489 operations on different types of hiatal hernias. The classification which he employs is as follows: (1) paraesophageal hiatal hernia, (2) hiatal hernia with elevation and displacement of the esophagus, and (3) hiatal hernia caused by a short esophagus.

In the paraesophageal type of hiatal hernia, comprising roughly 15% of the entire series, the esophagus is of normal length and is not elevated above the diaphragm. The stomach and possibly other abdominal viscera may herniate alongside of the esophagus into the posterior mediastinum and into either or both sides of the thoracic cavity. This type is most satisfactorily treated by surgery.

In the second type of hiatal hernia the esophagus is of normal length but its lower end is displaced and does not extend to the diaphragm. The stomach usually herniates into the posterior mediastinum or thoracic cavity. This form of hernia is the commonest, making up about 67% of the total series, and in this group fall most of the surgical failures and postoperative recurrences.

When the hiatal hernia is associated with a short esophagus, the latter may be of the congenital type (5%) or acquired type (13%). In the latter group the contractures resulting from ulceration and fibrosis are responsible for structural changes which draw the cardia of the stomach above the diaphragm. This condition is often associated with stenosis of the lower part of the esophagus.

The author feels that most esophageal hiatal hernias are basically congenital in origin.

Roentgenographic examination is most important in establishing the diagnosis, while esophagoscopy is essential for the determination of such associated conditions as esophagitis, peptic ulceration from reflux of gastric secretions, traumatic ulceration at the cardia, and strictures as well as spasm of the esophagus. Esophagoscopy must be regarded as a routine part of the general evaluation because the finding of lesions complicating the hernia, as well as lesions not related to the hernia, will often alter the method of management as well as the type of treatment required.

It is interesting to note that in the 489 cases in which hiatal hernia operations were performed approximately 3 previous erroneous clinical diagnoses were made per case before the correct diagnosis was established. In order of frequency these erroneous diagnoses were cholecystitis, cholelithiasis, gastric ulcer, duodenal ulcer, hyperacidity, secondary anemia, cardiac disease, carcinoma of the cardia, stricture of the esophagus, intestinal obstruction, appendicitis, and thoracic tumor.

The surgical techniques employed are illustrated, and the results of treatment are presented. It is concluded that only those patients whose symptoms are definitely related to the hernia and who do not respond to conservative measures should be treated surgically.

FRIEDBERG, Chicago.

BRONCHOGENIC CARCINOMA: CELL TYPE AND OTHER FACTORS RELATING TO PROGNOSIS. J. W. KIRKLIN, J. R. MCDONALD, O. T. CLAGETT, H. J. MOERSCH, and R. P. GAGE, Surg., Gynec. & Obst. **100**:429 (April) 1955.

The authors classify bronchogenic carcinoma into squamous-cell type, adenocarcinoma, small-cell carcinoma, and large-cell carcinoma. Among other primary types of lung cancer they also include bronchial adenoma, alveolar-cell tumor, lymphosarcoma, and fibrosarcoma.

Thoracotomy was performed in 48% of the total number of 767 cases cases of bronchogenic carcinoma. Resection with the hope of cure was done in 24% of the 767 cases. The survival rate for five years or more in the group for which curative resection was performed was 37%.

Survival rate following resection for adenoma of the bronchus is excellent; for small-cell carcinoma it is extremely poor. Large-cell types of carcinoma were found in 291 patients, but only 5% of these survived five years after resection.

In the group of patients with adenocarcinoma, comprising 97 cases, 26 had curative resections and there was a five-year survival rate of 11%.

The resectability rate of 34% was significantly higher in the squamous-cell group, and 42% of the patients surviving surgery were alive five years after resection.

It should be mentioned that the five-year rates quoted included only those patients who survived operation. The hospital mortality rate for curative pulmonary resection in proved bronchogenic carcinomas in the series was 13.6%.

Patients with adenocarcinoma and squamous-cell carcinoma have a relatively good prognosis provided resection is possible.

FRIEDBERG, Chicago.

DISCUSSION: INTRACRANIAL THROMBOPHLEBITIS. E. J. RADLEY-SMITH, Proc. Roy. Soc. Med. **48**:391 (May) 1955.

The Section on Otology, Royal Society of Medicine, met on Dec. 3, 1954, under the presidency of Josephine Collier, F.R.C.S. Mr. Radley-Smith, neurologist, held forth on intracranial complications affecting the large veins within the skull. He quoted from an article which stated that in 1951 these conditions had become almost a rarity since the introduction of the sulfa drugs. Admitting this fact, he thinks that thrombophlebitis still occurs and notes that "in the last three years 8 cases occurred at the Royal National Throat, Nose and Ear Hospital."

Cavernous sinus thrombosis, whatever its incidence, carries a very different prognosis than in the late 1920's. His last two cases had full recovery following "boil in the nose and tonsillitis." Treatment by antibiotics and diathermy followed early diagnosis. He is afraid that the anticoagulants for thrombosis may be delayed, and this is the natural barrier to any spreading of the infection. "In all intracranial thrombophlebitis prolonged medication with anticonvulsants is most wise but often overlooked!"

A table, set up in 1952, shows the main complications in 1379 mastoid operations. They are labyrinthitis, brain abscess, and lateral sinus thrombosis in the years 1921 to 1951. Brain abscess seems to be as common as formerly, since "many brain abscesses are the end-result of thrombophlebitis." Moreover, Radley-Smith states: "In a very general neurosurgical practice 15 of my last 29 brain abscesses came from infections of the ear or nose."

Otitic hydrocephalus should be kept in mind, since it is found as well as brain abscess in the presence of bone erosion due to cholesteatoma. It is insidious and may be forming even while signs and symptoms seem to be improving. The interval between active ear infection and the onset of high intracranial pressure may be from 4 to 100 days (his latest case required 38 days). In one patient with a "silent ear," the clinical diagnosis was "enteric fever," since no attention had been called to the aural focus. The author states that otitic hydrocephalus should be diagnosed early and treated energetically, "as cure is often possible." Antibiotics must be administered early. High intracranial pressure follows thrombosis of the superior longitudinal sinus. Lumbar puncture done early and often, even twice a day, gives time for recanalization of the sinus itself and formation of anastomatic venous channels. Staff and patient hate this procedure, but the relief is so immediate that it is well worth the effort. Epileptic fits are early, persistent, and common symptoms of high intracranial pressure. X-rays of the skull, A-P, may give much information, also ventriculography and arteriography. A differential must be made between cerebral abscess and thrombophlebitis, since the latter needs no definitive surgical treatment, while brain abscess usually demands surgery. Superior sinus thrombosis has long been recognized in the puerperium and should be kept in mind by the otologist as a complication of surgical otitis.

Mr. Norman Crabtree in the discussion contributed his experiences in otologic complications and set forth tables to show management and results. He concludes that since 1935 the total incidence of sinus thrombophlebitis has fallen to about a quarter. Acute mastoiditis being almost always controllable through surgery and the antibiotics, we must look to the chronic suppurative destructive lesions for present-day complications in otology. "Findings at operation varied from a little pus in the mastoid process to gross necrosis with pus under pressure. Cholesteatoma was present in only 2 of the chronic cases." The fact is declared "that in none of our cases since the introduction of penicillin has the internal jugular vein been ligated." The wisdom of this was doubted in earlier days, but Körner, Grünberg, and others making comparative studies could find no good reason for ligating. In fact, infective thrombi may form proximally to the obliteration. At the moment, the item for decision is whether a thrombosed sinus should be opened and the clot evacuated or left untouched after clearance of the adjacent tissues. Crabtree seems to believe that it makes little difference whether one opens the sinus wall and removes the clot or leaves the field in status quo. As for brain abscess, which used to be explored through the mastoid wound, " we would never dream of doing this now, any intracranial exploration being through an independent clean field." The point is made that all bacterial cultures should be made before therapy, and this is particularly important in acute exacerbations of chronic mastoiditis.

ABSTRACTOR'S COMMENT: Further discussion was engaged in by some 10 members of the audience, but little that is new or important was added to what we already know. There are naturally great differences in the management of the complications in otology here in the United States and in Europe. But in general, one may say that our results on the whole are as good as theirs, and that theirs are as good as ours. In spite of all "advances" in surgery, otologic and other, including the sulfas, antibiotics, and the exigencies of a situation, we still have to deal with two great factors, namely, the virulence of the infection and its terrain, and the resistance of a person to his enemy. Fortunately, we have been able in these latter days to offer some success in both of these spheres of influence, but the last word shall probably never be uttered in these ultimate matters of life and death.

I. W. VOORHEES, New York.

EXENTERATION OF THE FOSSA INFRATEMPORALIS AND OF THE EUSTACHIAN TUBE IN THE REMOVAL OF THE MAXILLARY CANCER. H. KIMURA, J. Oto-Rhino-Laryng. Soc. Japan **58**:24 (May) 1955.

Kimura (1954) reported on the therapeutic significance of the removal of the maxillary cancer by the new combined transzygomatic approach.

However, increased knowledge of long-range results in surgical procedure of the maxillary cancer has revealed that there are definitely cases in which the exenteration of the fossa infratemporalis is highly indicated.

To the surgical procedure of the exenteration of the fossa infratemporalis is suggested an addition of the new temporal incision, 10 cm. in length, beginning at the supra-auricular region, running longitudinally downward to the anterior side of the tragus.

The employment of the combined maxillary, zygomatic, and temporal incisions enables surgery of the following regions: regions of the frontal, ethmoid, and sphenoid sinuses, of the dura of the frontal and middle fossae, of the orbital and the fossa temporalis, of the fossa infratemporalis and of the fossa pterygopalationa, and of the epipharynx.

By following this plan, even in the most extensive involvement in the cancer, it is possible to attack the tumor with greater precision than ever before.

The generally accepted indication for the Kocher or Velpeau incision is limited localization of the diseased tissue in the maxillary sinus or the gingiva.

In extensive lesions which involve the tubal orifice, the posterior end of the turbinate, the floor of the nasal cavity, the dura, and the pterygoid muscle, the Kocher operation is contraindicated. In general, as described above, the use of suggested temporal incision combined with the zygomatic one saves the Kocher operation from remaining an inexact and potentially dangerous procedure.

A perfect surgical procedure for the pterygoid muscle, Eustachian tube, the sphenoid-frontal marrow, and the dura is undoubtedly the most logical measure in the clinical treatment of the maxillary cancer.

HARA, Los Angeles.

Books

La voix: Cours international de phonologie et de phoniatrie de Paris (1953). Prepared under the direction of Prof. A. Aubin. Price, 5000 francs. Pp. 434, with 300 illustrations. Norbert Maloine, 27 rue de l'École-de-Médecine, Paris, 6e, 1953.

It is gratifying to have in a single volume a series of enlightening lectures on almost every phase of study in which the voice is involved. The lectures were first presented as a course to otolaryngologists by outstanding representatives in the fields of audiology, laryngology, phoniatry, psychology, radio broadcasting, and music. The topics are treated from a theoretical, practical, and—where pertinent—therapeutic point of view.

In its present form, the book's usefulness as a reference text is decreased by the absence of an index. The lectures are presented in chronological order of their delivery, thereby relegating some of the basic information, i. e., acoustic theory, description of electroacoustic apparatus, etc., to the middle and back of the book.

Although somewhat short, the chapters on the anatomy and physiology of the larynx are well done. Here the traditional myoelastic theory of vocal-cord vibration is rejected in favor of Husson's neurochronoaxic theory. The larynx is considered to behave like a neuromuscular effector, and the opening and closing of the vocal folds is said to depend on the polyphasic behavior of the recurrent laryngeal nerve—acting much like the auditory nerve fibers in Weaver's "Volley Theory of Hearing." The implication appears to exist, however, that the greater part of the acoustic power comes from the vibrating glottal lips rather than—as Martin Joos has pointed out—from the pulsations of air flow through the glottis. Throughout the book is emphasized the view that the voice is primarily controlled by the ear acting as a delayed feedback proprioceptor. Some interesting experiments with singers' voices, notably Caruso's, support the theory that autotraumatism is responsible for the progressive hearing loss at 2000 cps and above. Since a person is only able to reproduce sounds he is capable of hearing, the singer gradually loses his ability to reproduce the higher harmonics necessary to a rich voice.

Not to be overlooked are the excellent roentgenograms of successive stages of movements of the soft palate. The chapter on medicolegal techniques in solving problems of laryngology and phoniatry—especially malingering—is informative.

From the bibliography it appears that the lecturers are aware of American research going on in the several fields discussed, yet the work currently conducted in spectrography by the Bell Laboratories is relegated to a nether plane. The investigations with the pattern playback conducted by Cooper, Delattre, and Liberman at the Haskins Laboratories are not mentioned. The chapter concerned with acoustic phonetics does not include the recent theory that the resonance cavities in the vocal tract act as glottal-tone filters. No distinction is drawn between resonance and reinforcement in speech production.

The section on musical acoustics could benefit from a discussion of Parry Moon's macro-microstructural scale of musical notation. The claim that the choice of one's profession can be determined from the relative height of one's palate is, to us, untenable. It is surprising that one lecturer appears ignorant of the role of formants 1, 2, and 3 in vowel production.

As suggested elsewhere by the author of this review (Belasco, S.: The Psychoacoustic Interpretation of Vowel Color Preferences in French Rime, Monograph Series on Languages and Linguistics [to be published]), it seems more plausible that the ear's ability to identify the same vowel when spoken by different persons is found in the relationship of formants 1, 2, and 3 to some fundamental frequency (harmonic spacing on the basilar membrane) rather than in "fusion or sonance."

Despite certain shortcomings, the book is recommended to those who wish to acquire a good perspective of the many fields associated with the voice.

Directory of Otolaryngological Societies *

FOREIGN AND INTERNATIONAL

Canadian Otolaryngological Society
(Société Canadienne d'Otolaryngologie)

President: Dr. D. S. Gorrell, 110 Medical Arts Building, Calgary, Alta.
Secretary: Dr. G. Arnold Henry, 328 Medical Arts Building, Toronto.
Place: Chateau Frontenac, Quebec, Canada. Time: June 8-9, 1956.

International Bronchoesophagological Society

President: Dr. Antonio da Costa Quinta, Lisbon, Portugal.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fourth International Congress of Bronchoesophagology.
Place: Buenos Aires, Argentina. Time: Oct. 28-29, 1955.
President of Congress: Dr. Antonio Carrascosa.

International Congress of Audiology

Place: Leyden, Netherlands.
General Secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

International Course in Paedo-Audiology

Place: Groningen, Netherlands.
General secretary: Dr. H. C. Huizing, 182 Oostersingel, Groningen, Holland.

Pan-American Association of Oto-Rhino-Laryngology and Broncho-Esophagology

President: Dr. Juan Manuel Tato, Azcuenaga 235, Buenos Aires, Argentina.
Secretary: Dr. Chevalier L. Jackson, 3401 N. Broad St., Philadelphia 40.
Meeting: Fifth Pan-American Congress of Oto-Rhino-Laryngology and Broncho-Esophagology.
Place: San Juan, Puerto Rico. Time: April 8-12, 1956.
President of Congress: Dr. Juan H. Font, Medical Arts Building, San Juan.

Sixth International Congress of Otolaryngology.

President: Dr. Arthur W. Proetz, 3720 Washington Blvd., St. Louis.
General Secretary: Dr. Paul H. Holinger, 700 N. Michigan Ave., Chicago 11.
Place: Hotel Statler, Washington, D. C. Time: May 5-10, 1957.

NATIONAL

American Medical Association, Scientific Assembly, Section on Laryngology, Otology and Rhinology

Chairman: Dr. John R. Lindsay, Chicago.
Secretary: Dr. Hugh A. Kuhn, 112 Rimbach St., Hammond, Ind.

American Academy of Ophthalmology and Otolaryngology

President: Dr. Algernon B. Reese, 73 E. 71st St., New York 21.
Executive Secretary-Treasurer: Dr. William L. Benedict, 100-1st Ave., Bldg., Rochester, Minn.
Place: Palmer House, Chicago. Time: Oct. 9-15, 1955.

* Secretaries of societies are requested to furnish the information necessary to keep this list up to date.

AMERICAN BOARD OF OTOLARYNGOLOGY

President: Dr. Frederick T. Hill, Professional Building, Waterville, Maine.
Secretary-Treasurer: Dr. Dean M. Lierle, University Hospitals, Iowa City.
Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 6-11, 1956.

AMERICAN BRONCHO-ESOPHAGOLOGICAL ASSOCIATION

President: Dr. Daniel S. Cunning, 115 E. 65th St., New York 21.
Secretary: Dr. F. Johnson Putney, 1719 Rittenhouse Sq., Philadelphia 3.
Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 15-16, 1956 (afternoons only).

AMERICAN LARYNGOLOGICAL ASSOCIATION

President: Dr. Bernard J. McMahon, 8230 Forsyth Blvd., Clayton 24, Mo.
Secretary: Dr. Harry P. Schenck, 326 S. 19th St., Philadelphia 3.
Place: Seigniory Club, Montreal, Canada. Time: May 13-14, 1956.

AMERICAN LARYNGOLOGICAL, RHINOLOGICAL AND OTOLOGICAL SOCIETY, INC.

President: Dr. Dean M. Lierle, Iowa City.
Secretary: Dr. C. Stewart Nash, 708 Medical Arts Bldg., Rochester 7, N. Y.
Place: Sheraton-Mount Royal Hotel, Montreal, Canada. Time: May 15-17, 1956 (mornings only).

SECTIONS:

Eastern.—Chairman: Dr. John A. Murtagh, Hanover, N. H.
Place: The Statler Hotel, Boston. Time: Jan. 13, 1956.

Southern.—Chairman: Dr. J. M. Robison, Houston, Texas.
Place: The Shamrock, Houston, Texas. Time: Jan. 27-28, 1956.

Middle.—Chairman: Dr. William H. Craddock, Cincinnati.
Place: The Netherlands Plaza, Cincinnati. Time: Jan. 16, 1956.

Western.—Chairman: Dr. David D. De Weese, Portland, Ore.
Place: County Medical Society Building, San Francisco. Time: Jan. 21, 1956.

AMERICAN OTOLOGICAL SOCIETY, INC.

President: Dr. William J. McNally, 1509 Sherbrooke St. West, Montreal 25, Canada.
Secretary-Treasurer: Dr. Lawrence R. Boies, 90 S. Ninth St., Minneapolis 2.
Place: Seigniory Club, Montreal, Canada. Time: May 11-12, 1956.

AMERICAN OTORHINOLOGIC SOCIETY FOR THE ADVANCEMENT OF PLASTIC AND RECONSTRUCTIVE SURGERY, INC.

President: Dr. Joseph Gilbert.
Secretary: Dr. Louis Joel Feit, 66 Park Ave., New York 16.

AMERICAN SOCIETY OF OPHTHALMOLOGIC AND OTOLARYNGOLOGIC ALLERGY

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Place: Palmer House, Chicago. Time: 1955.

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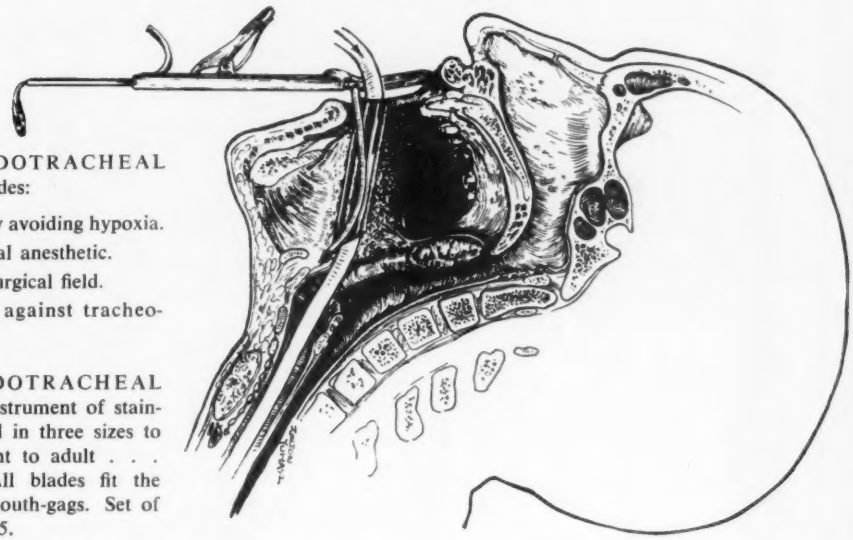

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*Barton, R. T.: Instrument for endotracheal anesthesia during oro-pharyngeal surgery. J. A. M. A. 153:1017 (Nov. 14) 1953.

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* See page 662 AMA Archives of Otolaryngology, June 1955. For other instruments designed by Dr. Benito B. Rish refer to:
AMA Archives of Otolaryngology
February 1953, Vol. 57, pp. 206-209
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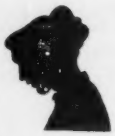

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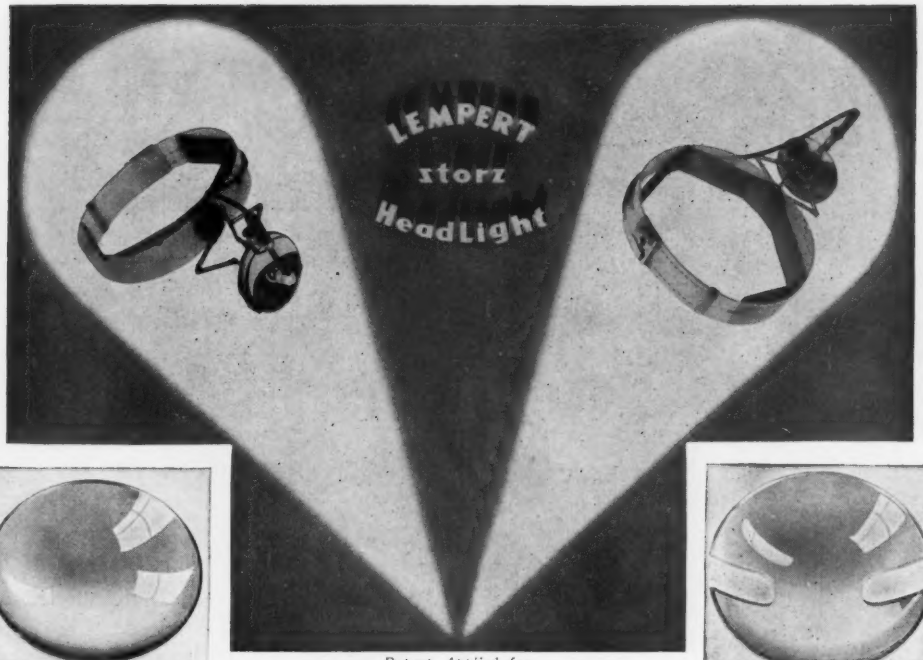

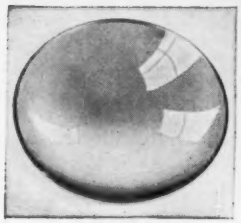

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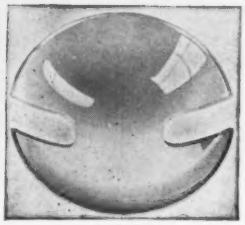

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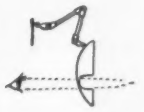

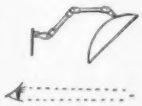

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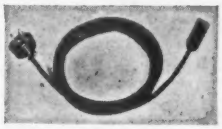

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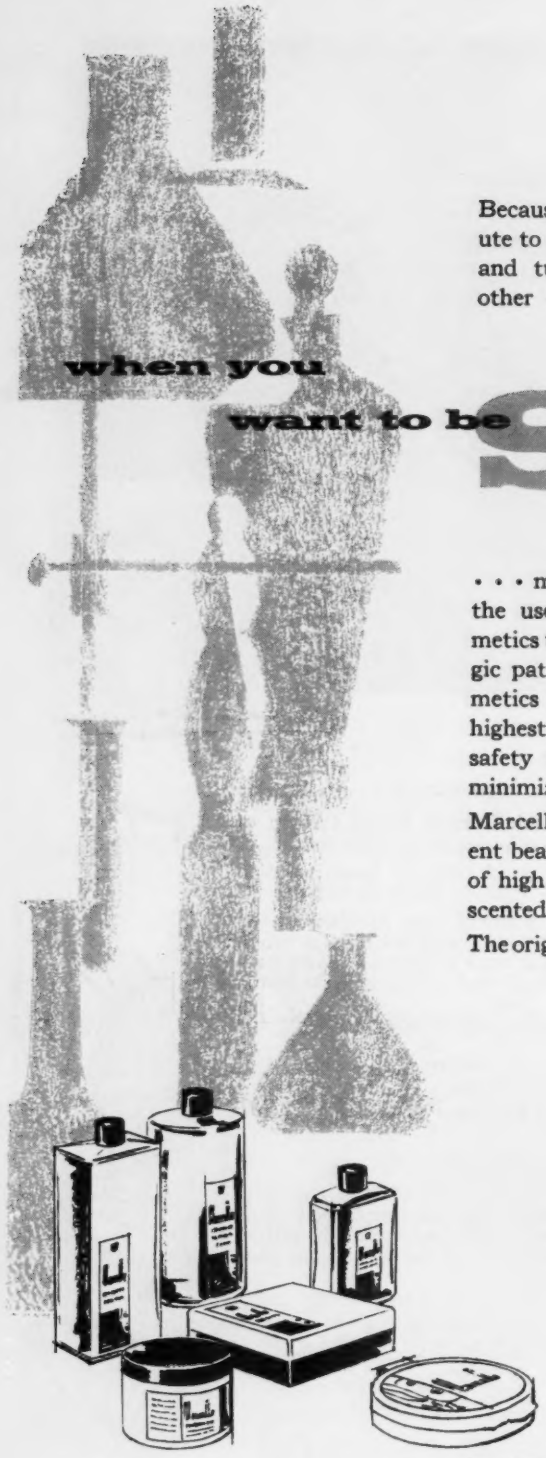

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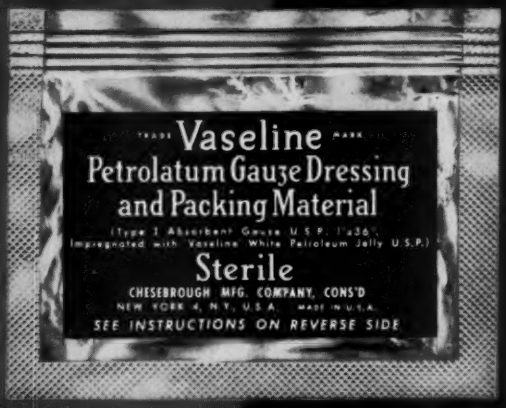
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References: 1. Gershenfeld, L., Am. Jl. Pharm.: 126:112, 1954.
2. Yarlett, M. A., Gershenfeld, L., McClenahan, W. S.: Drug Standards 22:205, 1954.

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